

*Fig. 1*

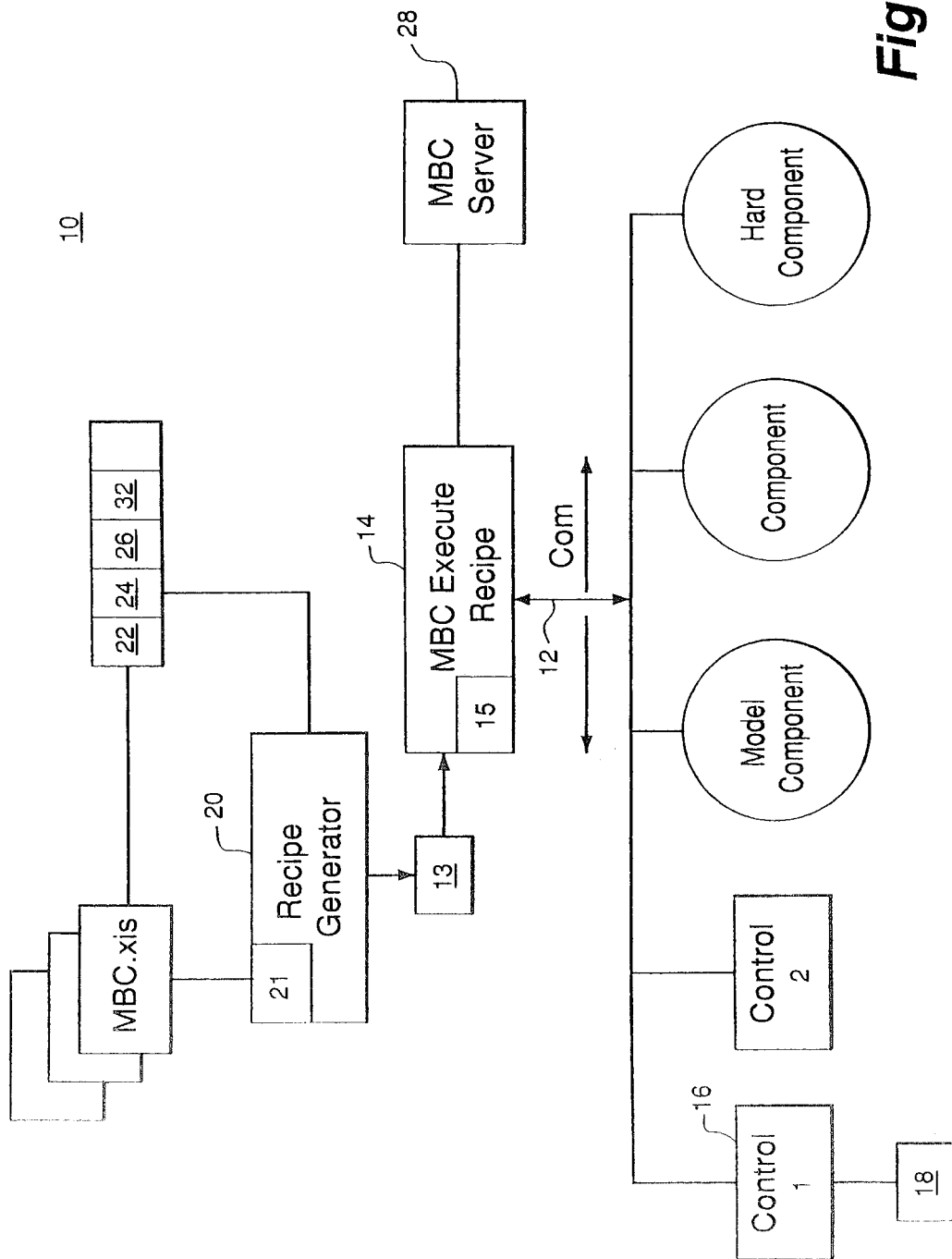
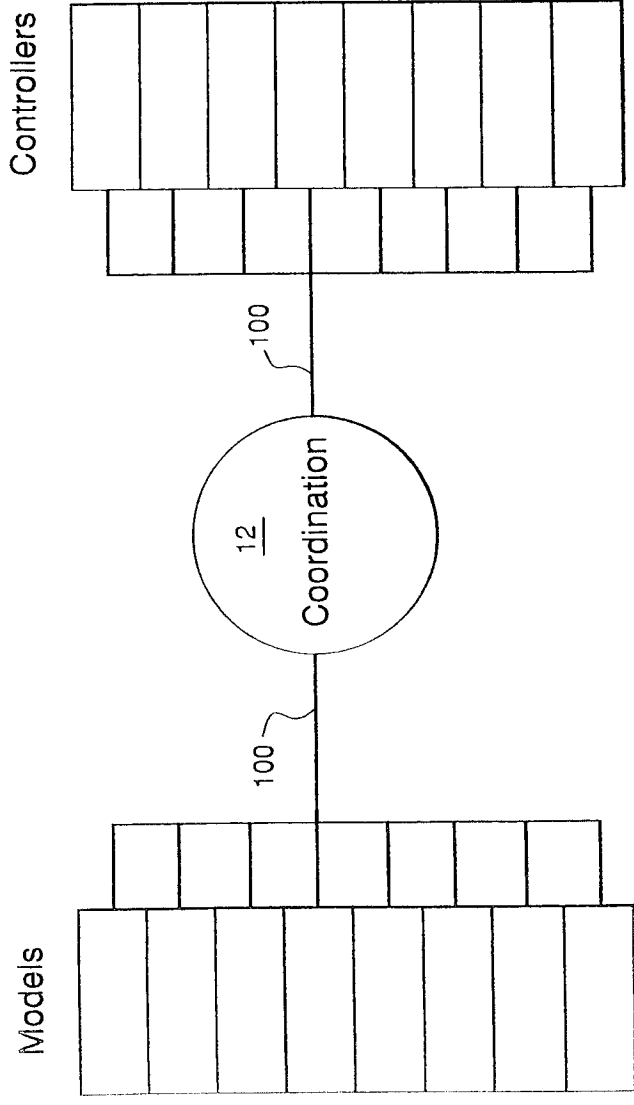


Fig. 2



**Fig. 2A**

Model Based Control IDE - (Recipe Edit window)

File View Tools Help

Recipe Components

- MVAgitator1
- MV/Air
- MVHotWater
- MVWaterJacket1
- OPCModel
- OPCRunTime
- PVAcetoneDosing
- PVAgitator2
- PV/Air
- PVCirculatingWater
- PVDecant
- PVDisolverFeed
- PVDrain2
- PVExhaust
- PVFlush
- PVHopper
- PVLasentec

Recipe Steps

Step	Move On Function	Loop
Step 1	No	False
Step 2	No	False
Step 3	No	False
Step 4	No	False

Recipe Tree Recipe Sheet

Watch 1 Watch 2 Debug

Status 11/6/2001 8:45 AM

Recipe Edit Window

Recipe Steps	Move On function	Loop	LoopTime	StepTime
Step 1	No	False	10	100
Step 2	No	False	0	0
Step 3	No	False	0	0

Recipe Tree Recipe Sheet

Recipe Step Detail

Step No:  Description:

☒ Pre-Process Step

☒ Post-Process Step

Component Commands

Loop Control

Move On:

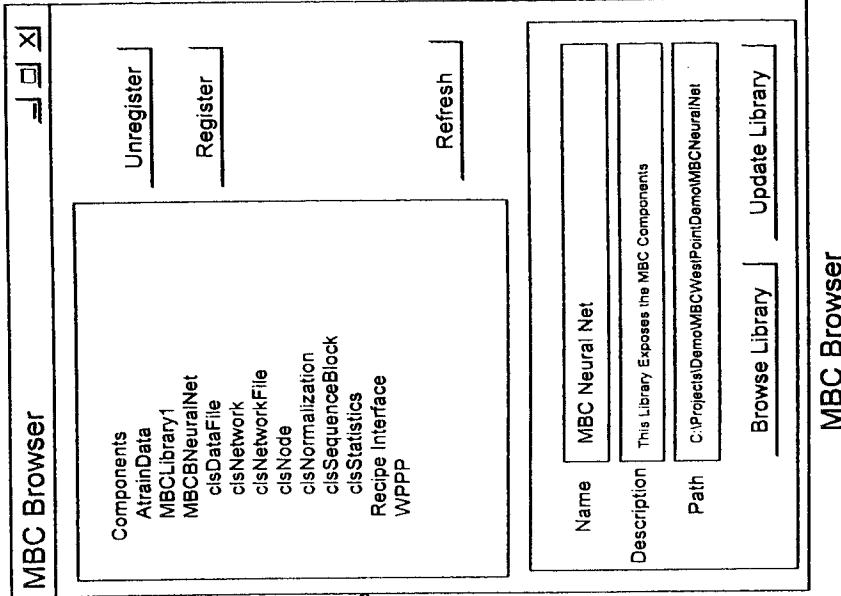
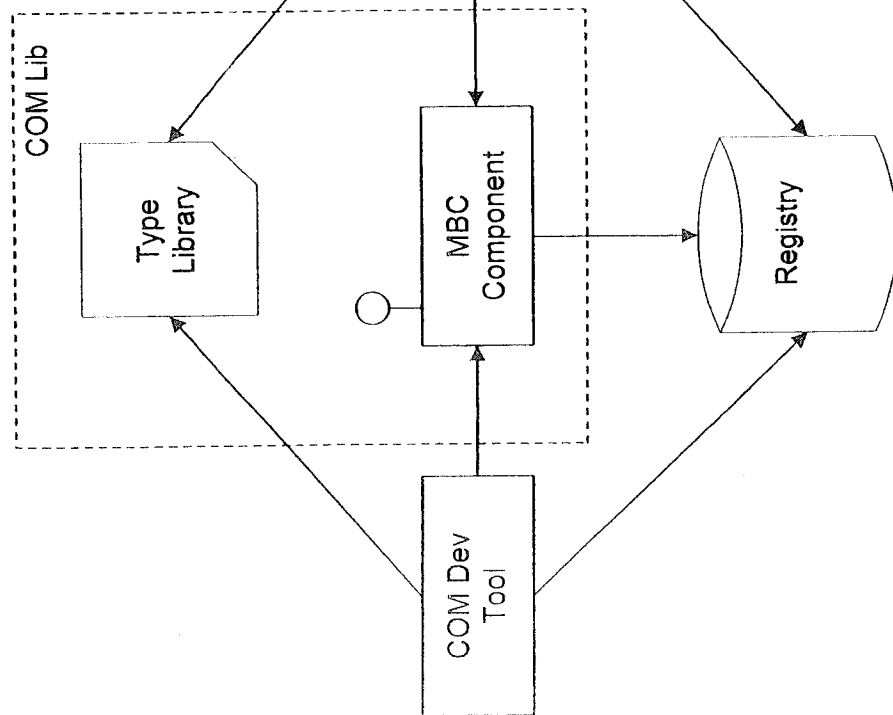
Loop Time:

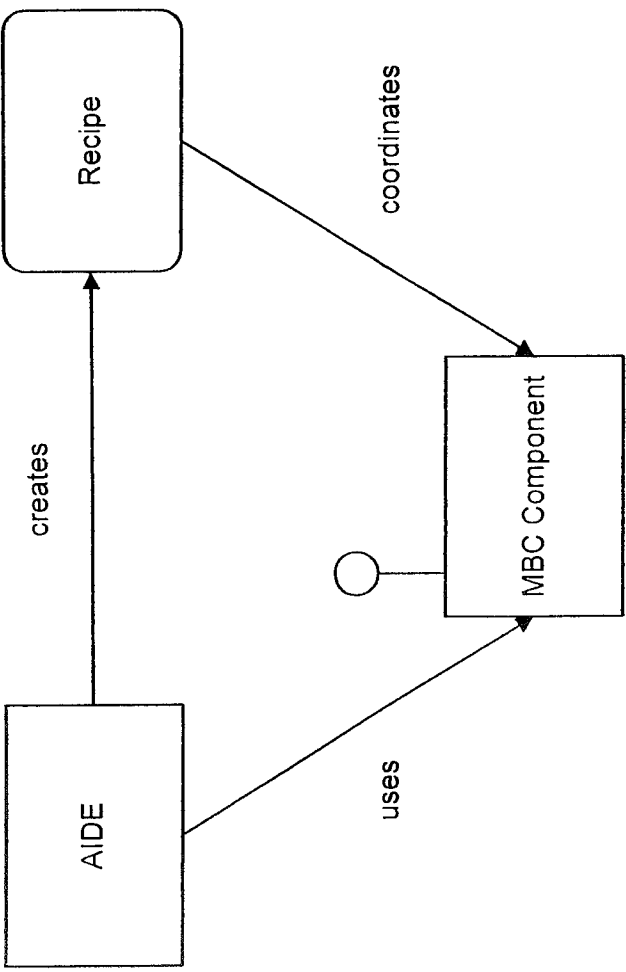
Step Time:  Units:

First Prev Next Last

Fig. 3

Fig. 4





**Fig. 5**

Fig. 6

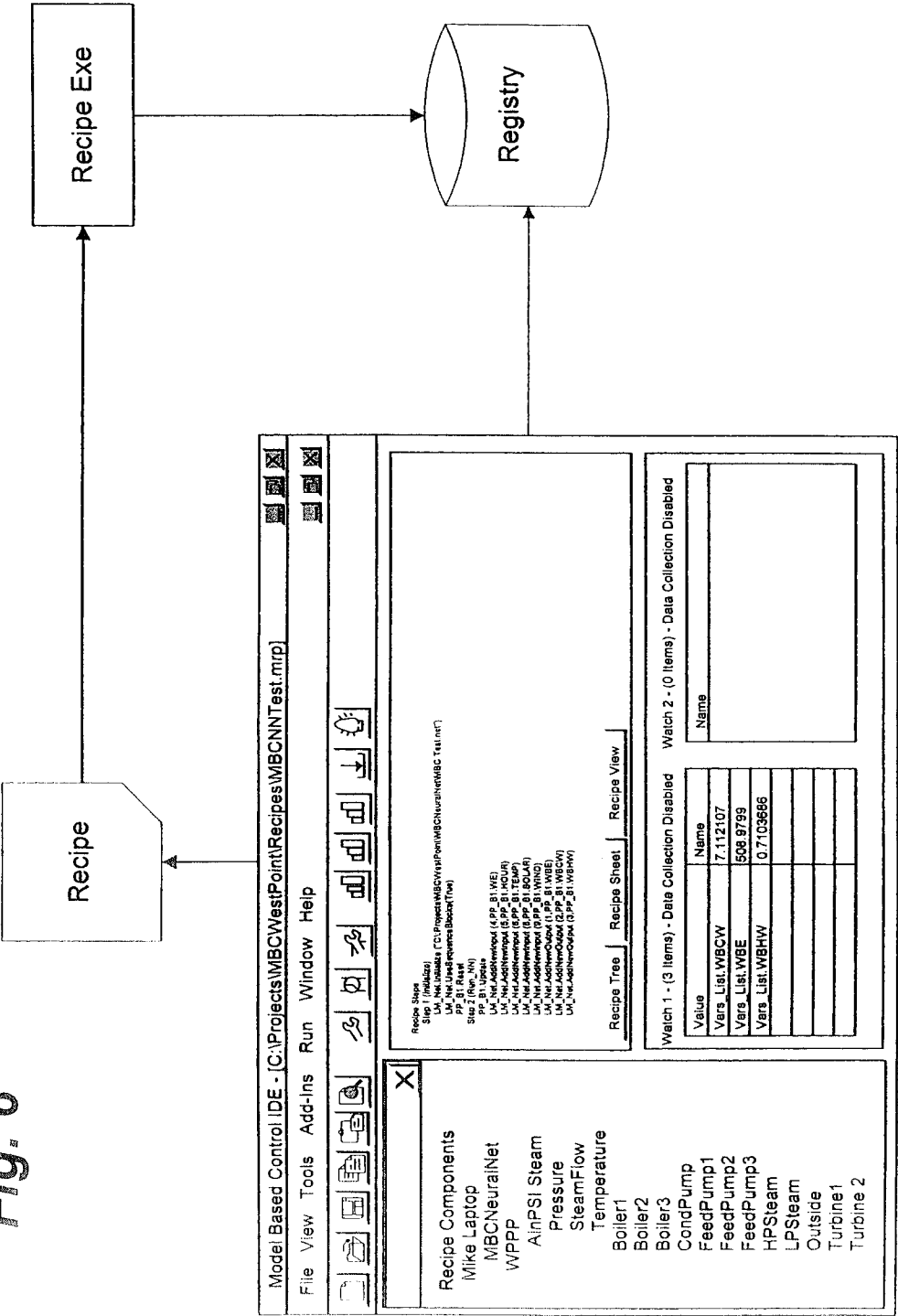


Fig. 7

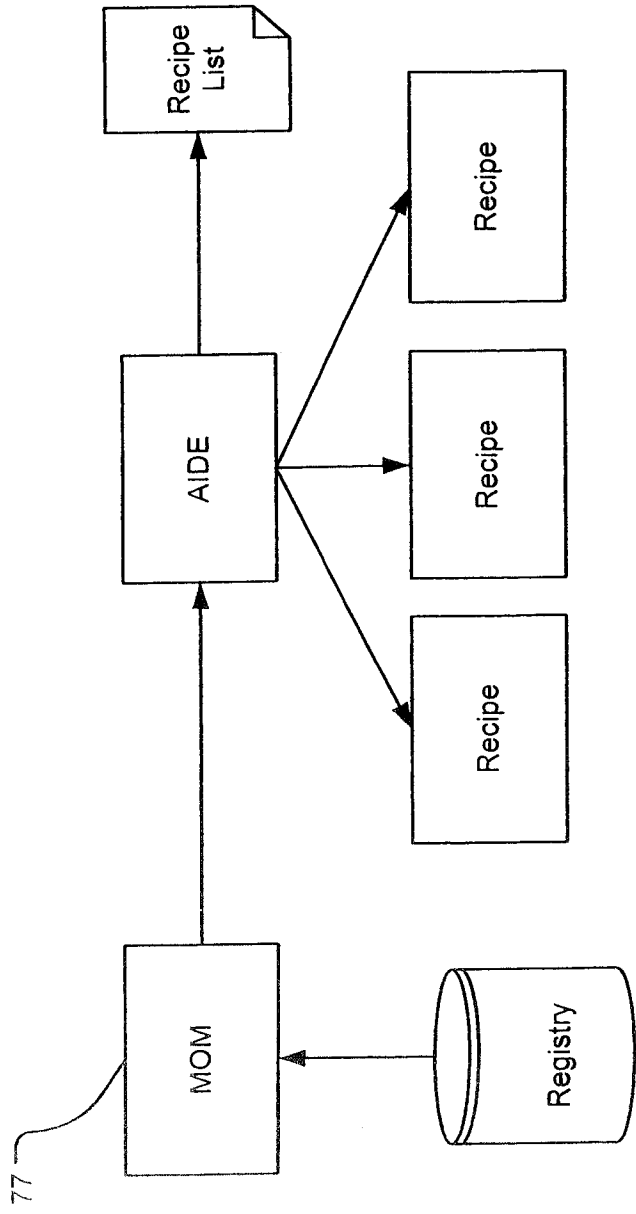
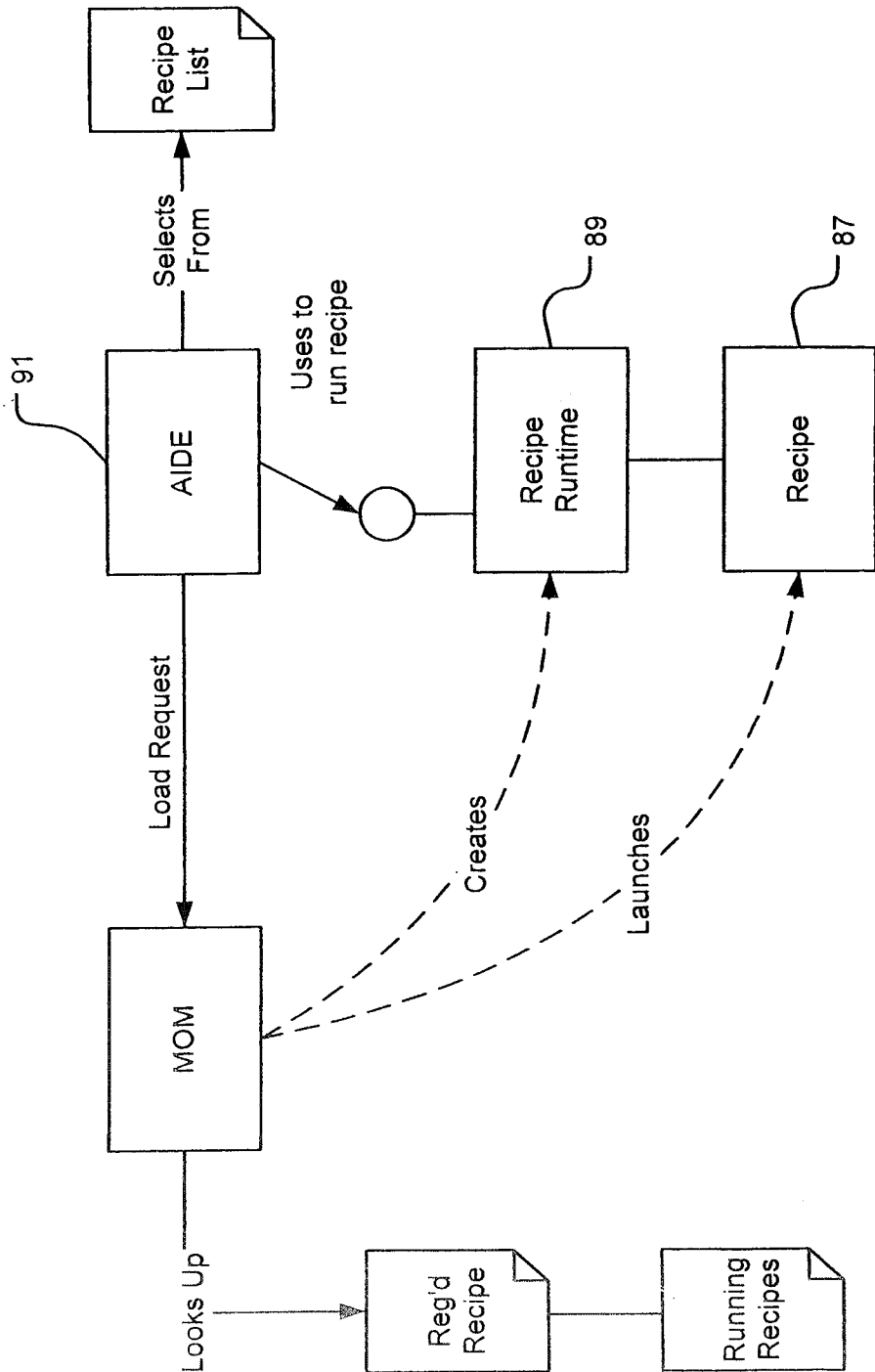




Fig. 8



**Fig. 9**

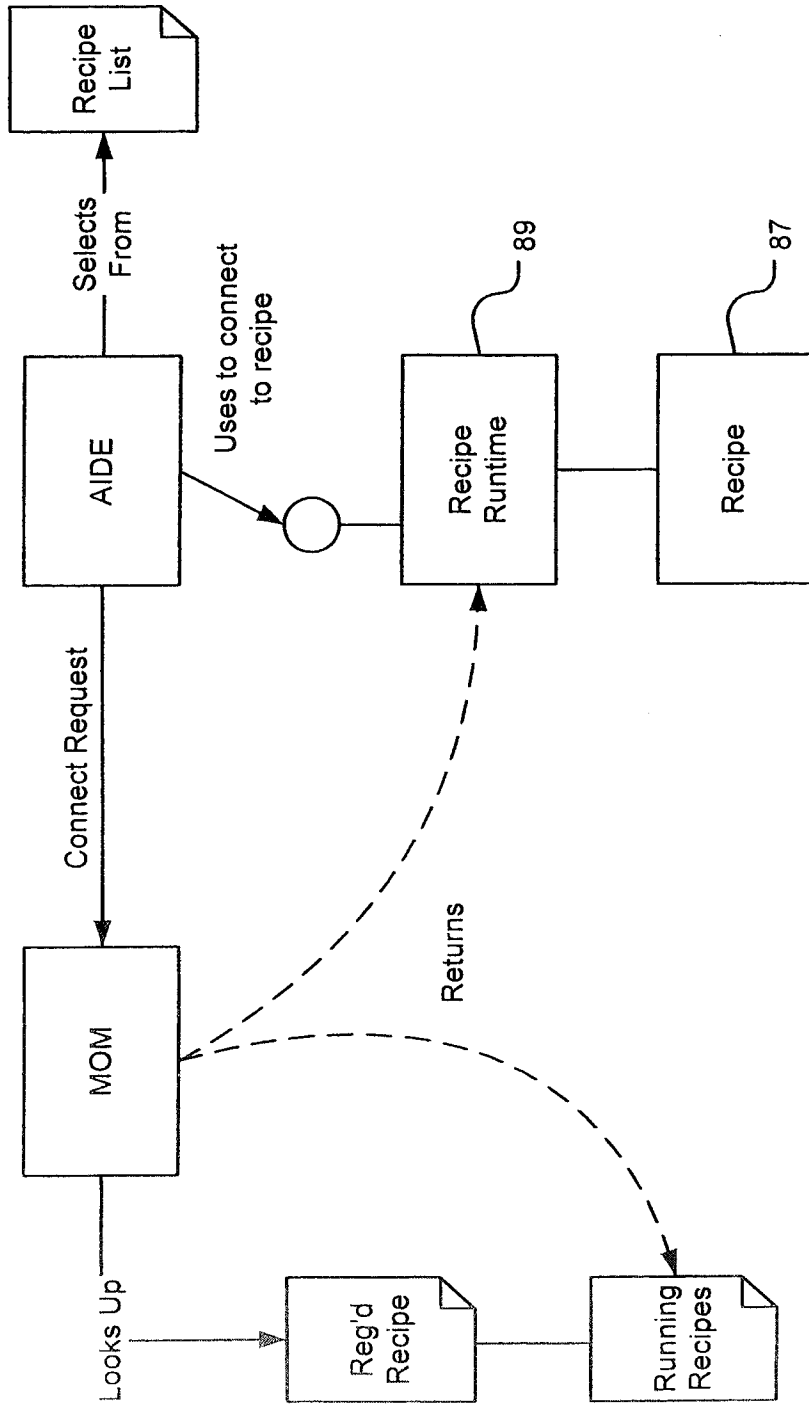


Fig. 10

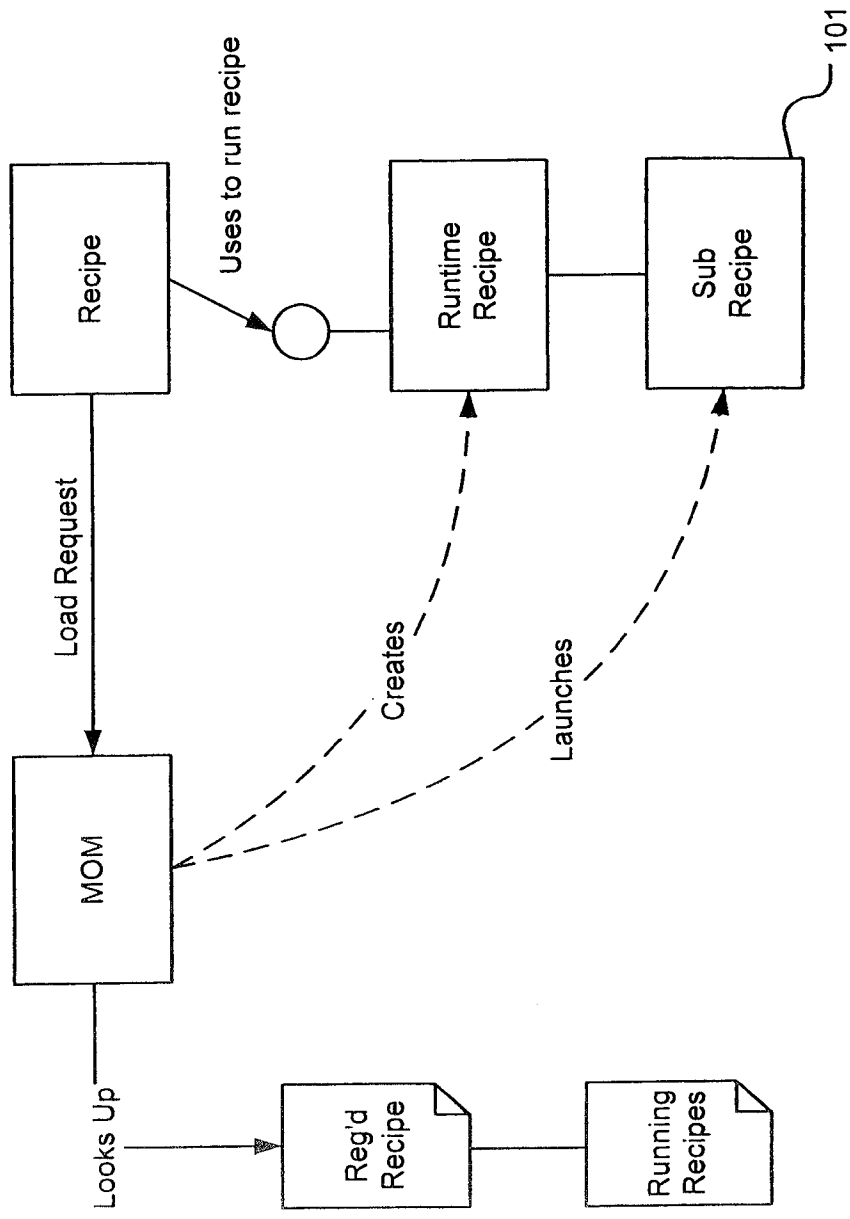


Fig. 11

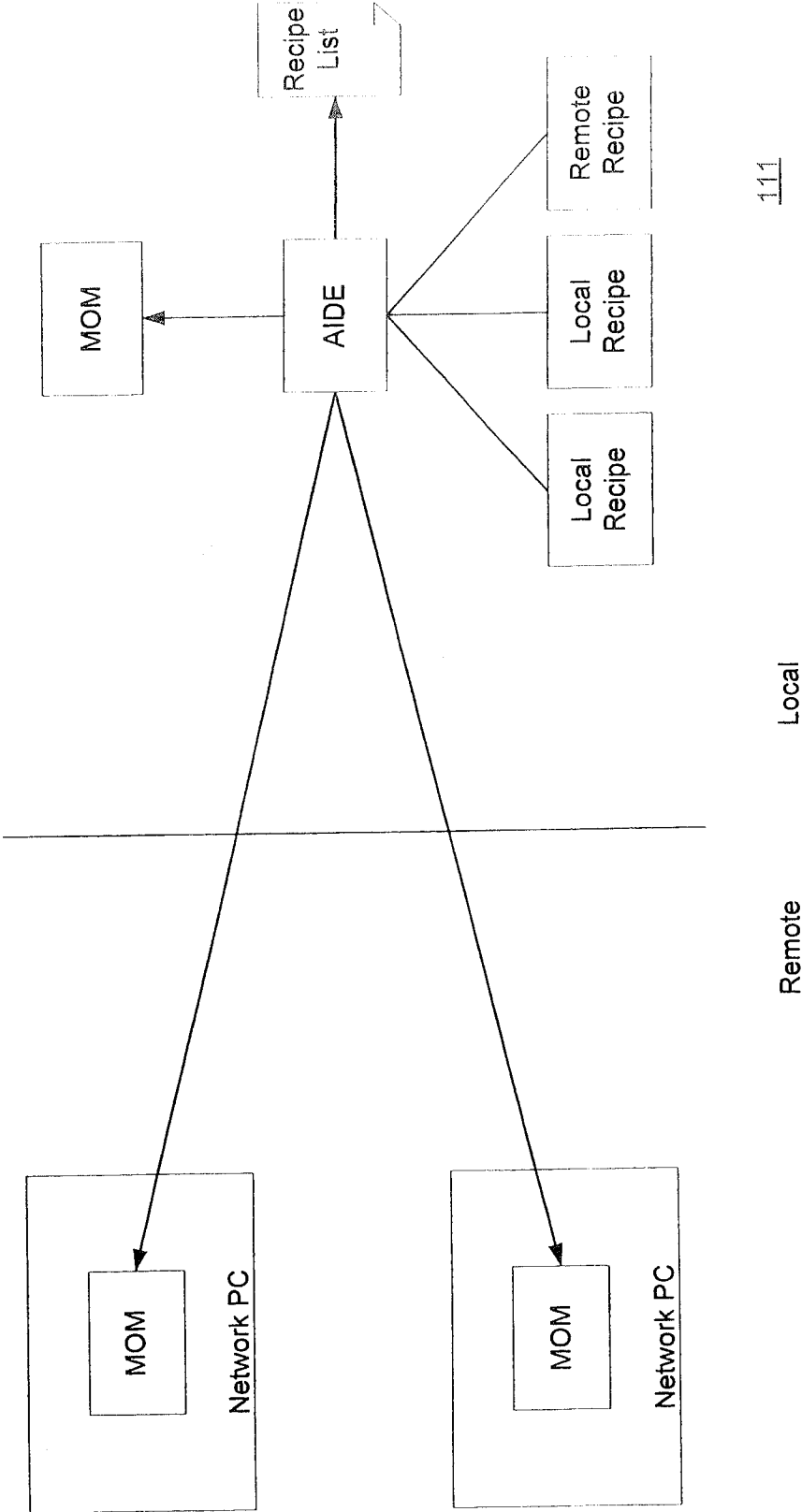


Fig. 12

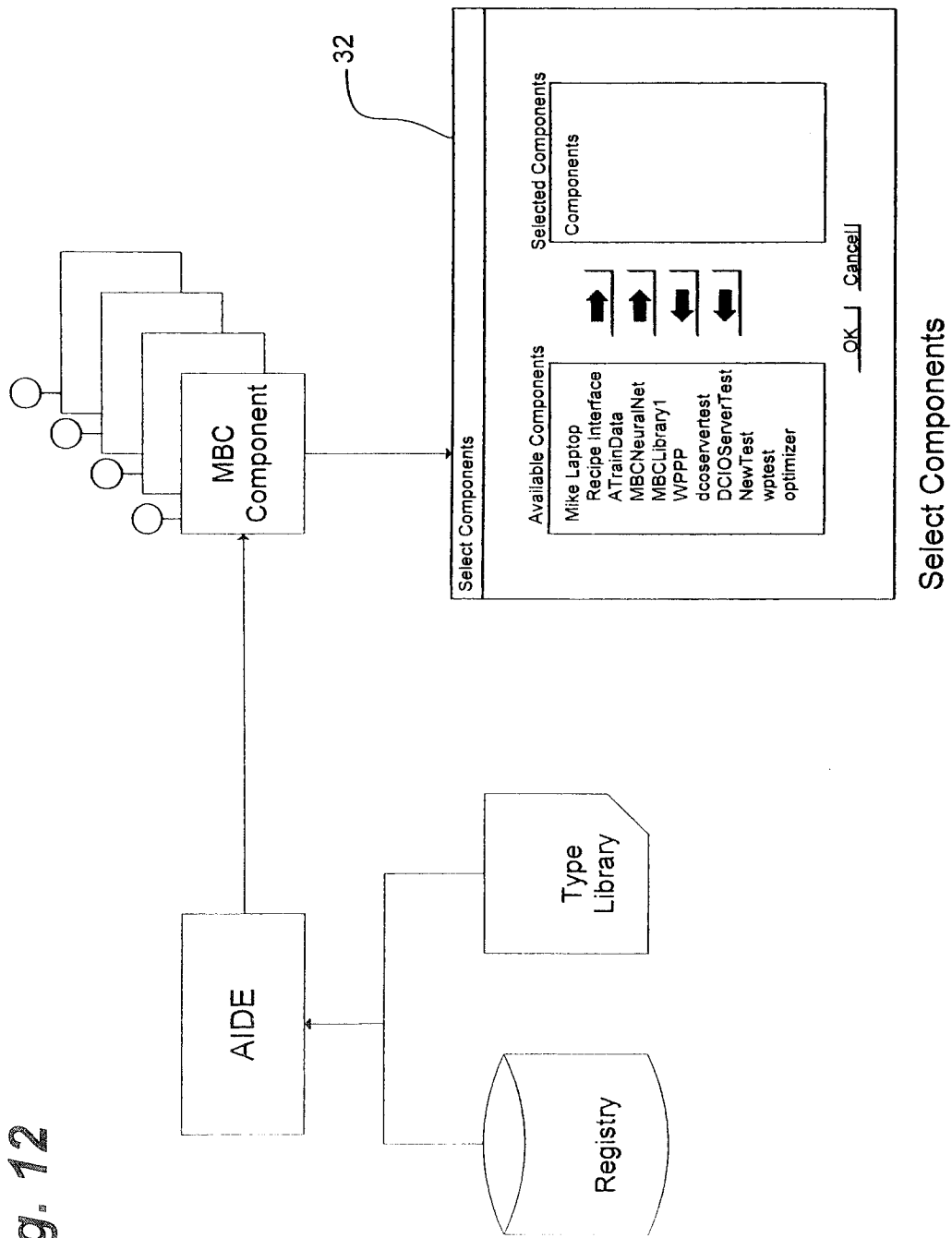


Fig. 13

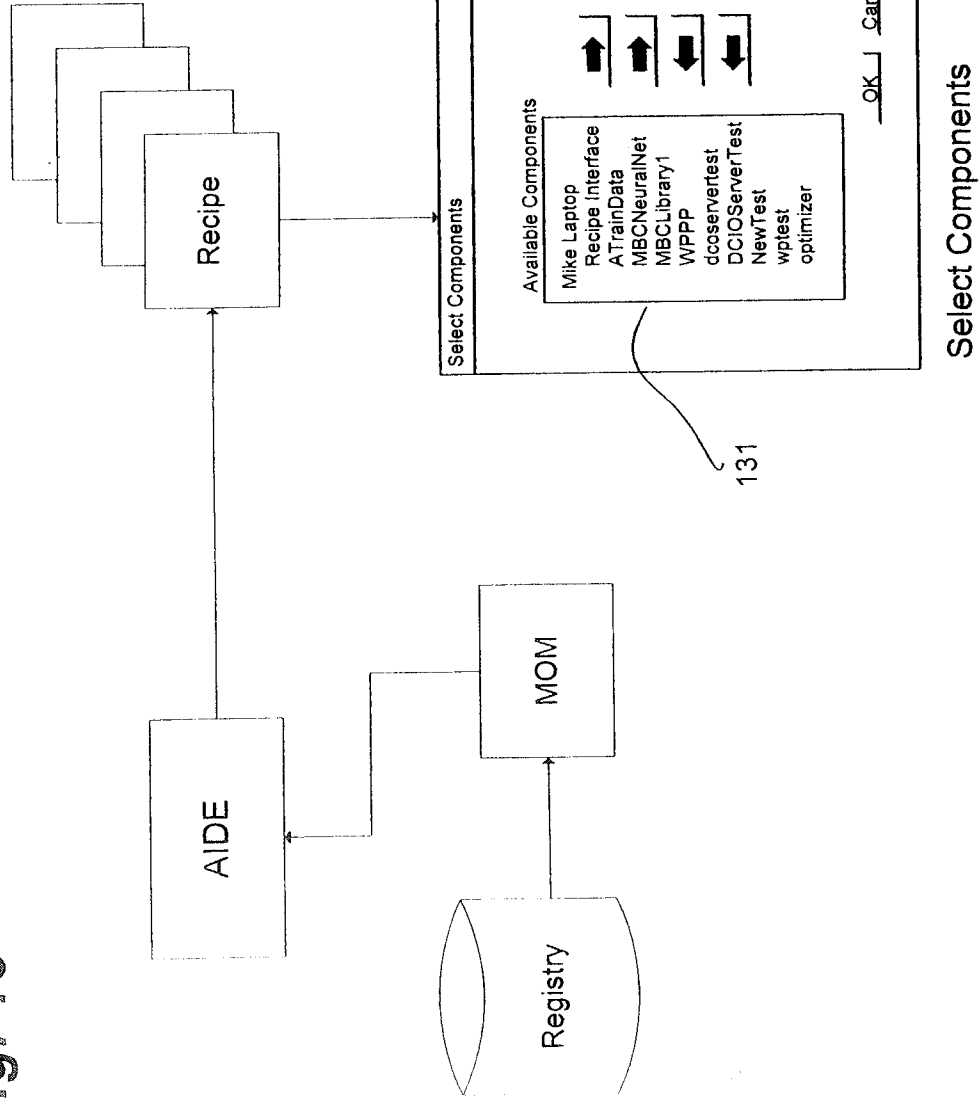
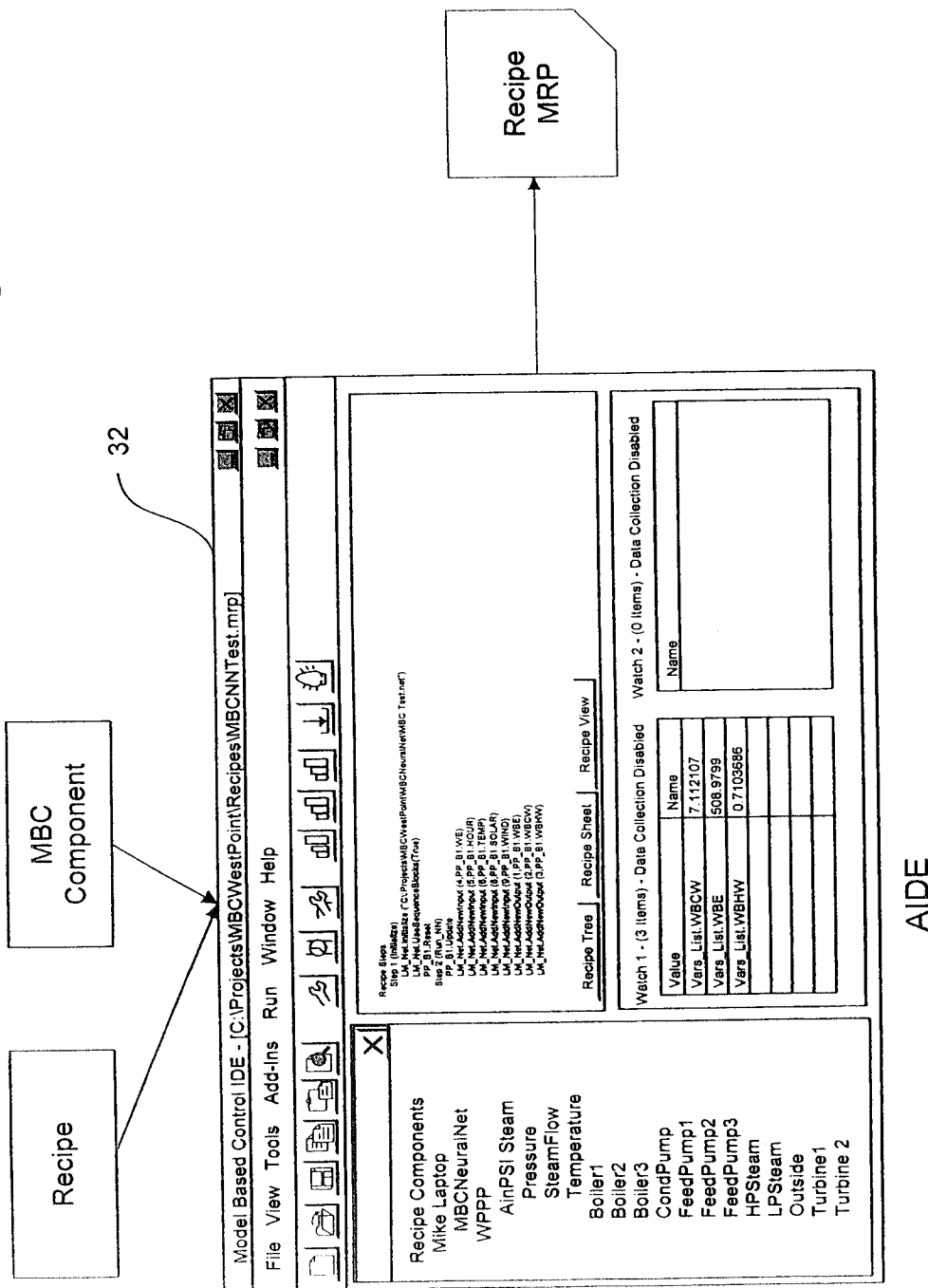


Fig. 14



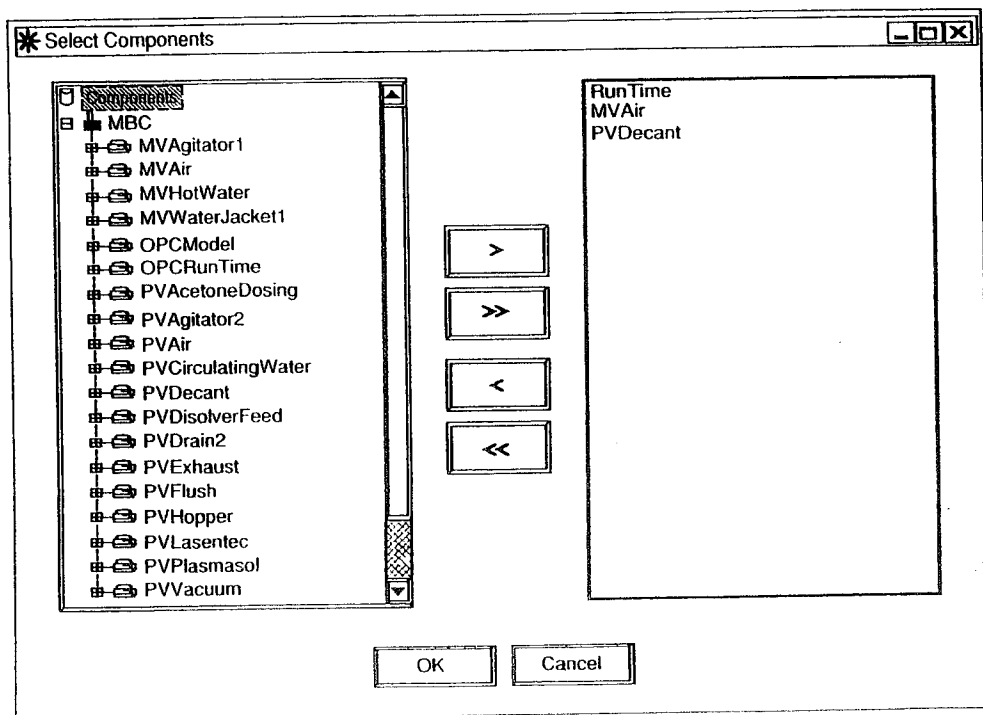
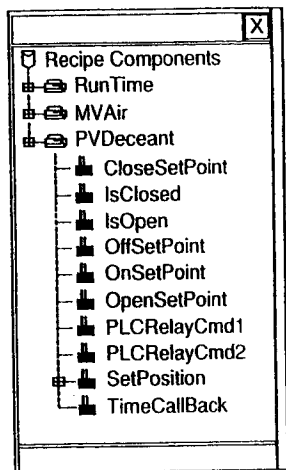


Fig. 15



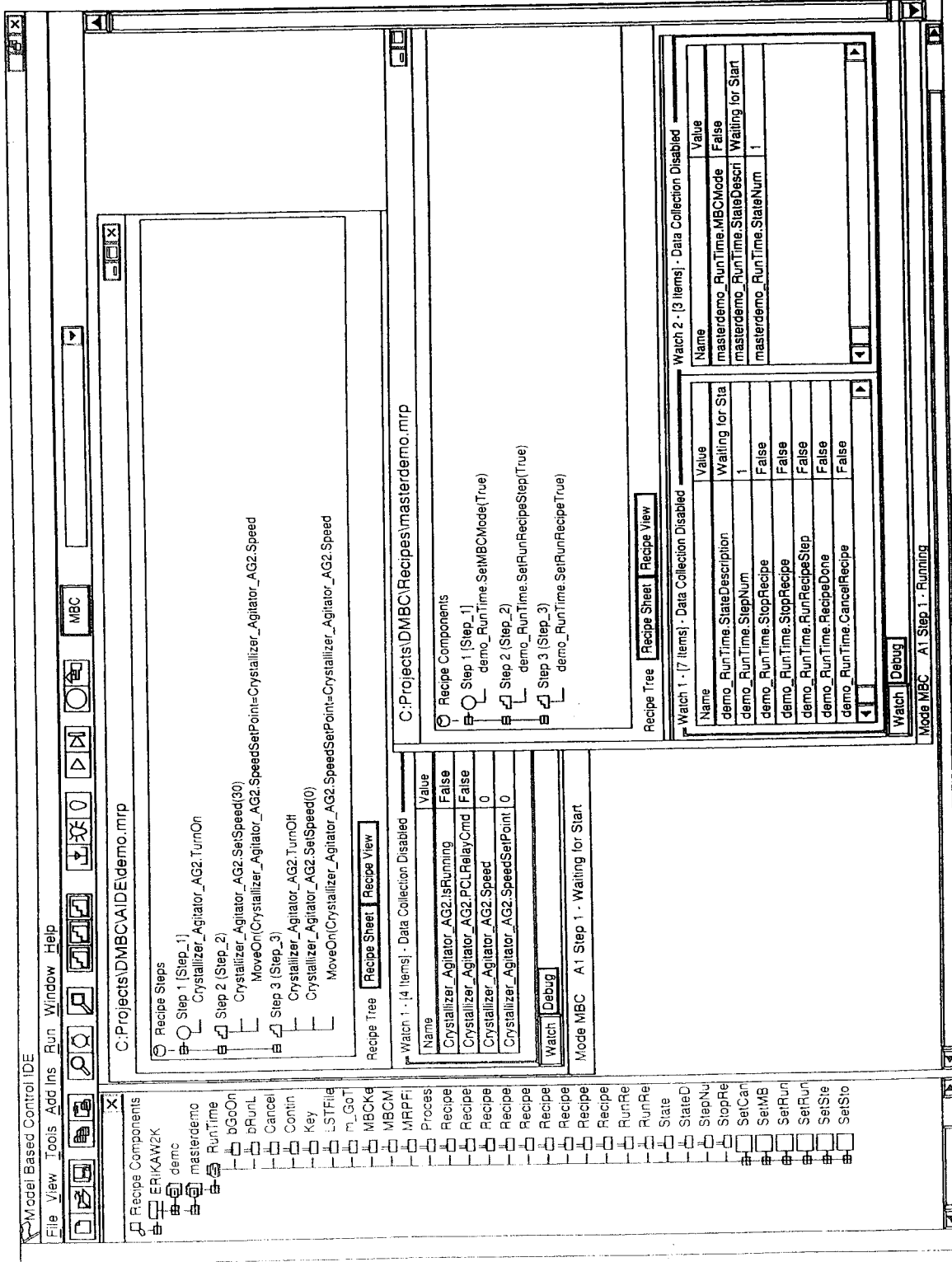
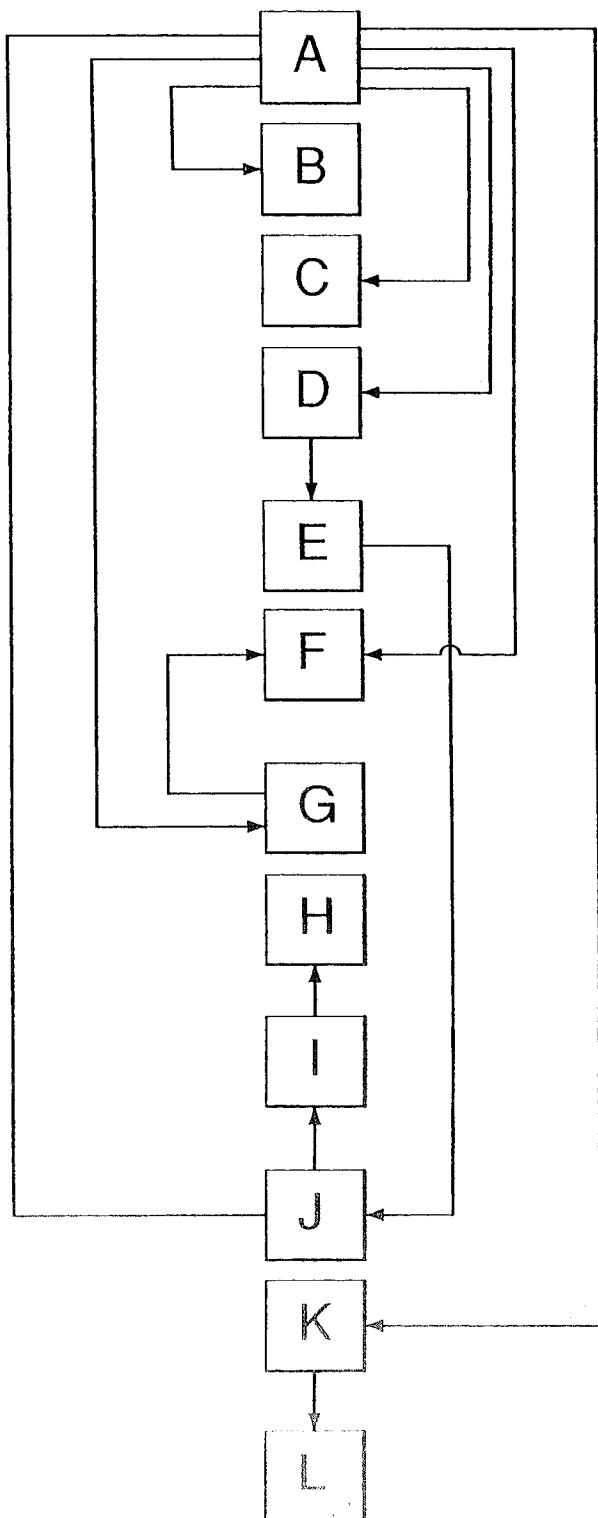


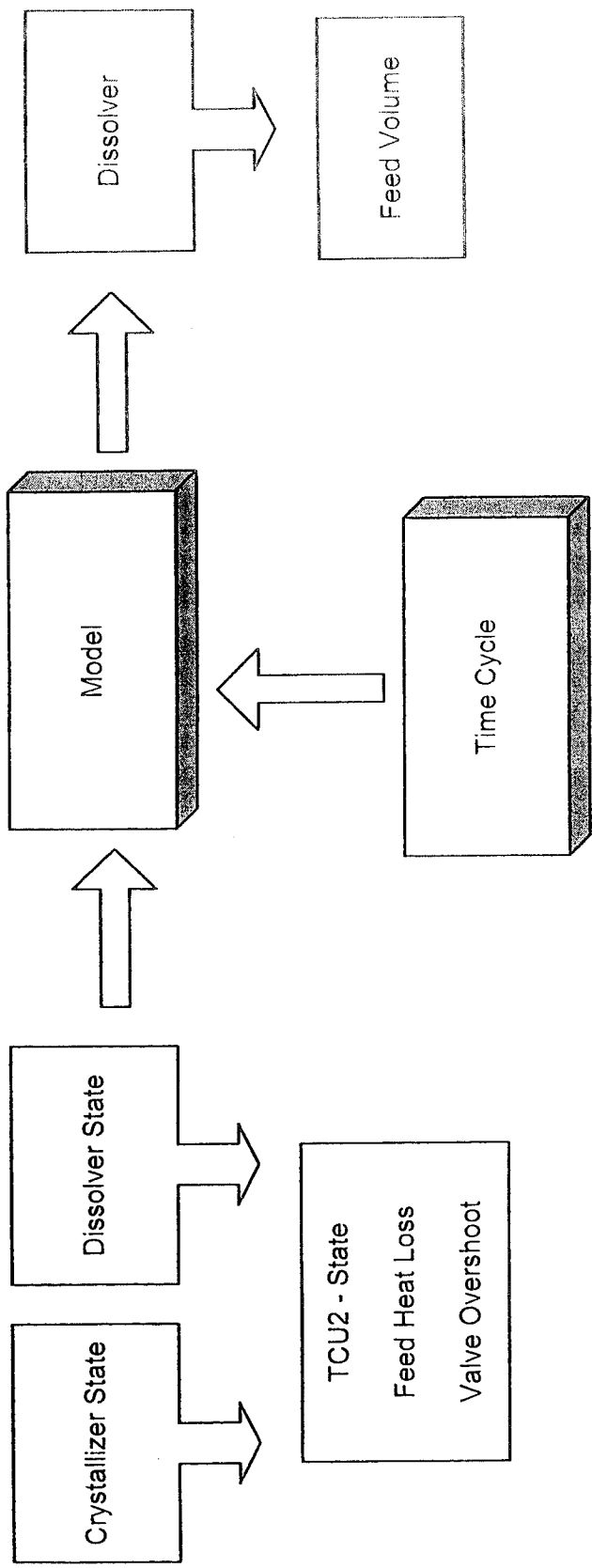
Fig. 16



**Fig. 17**

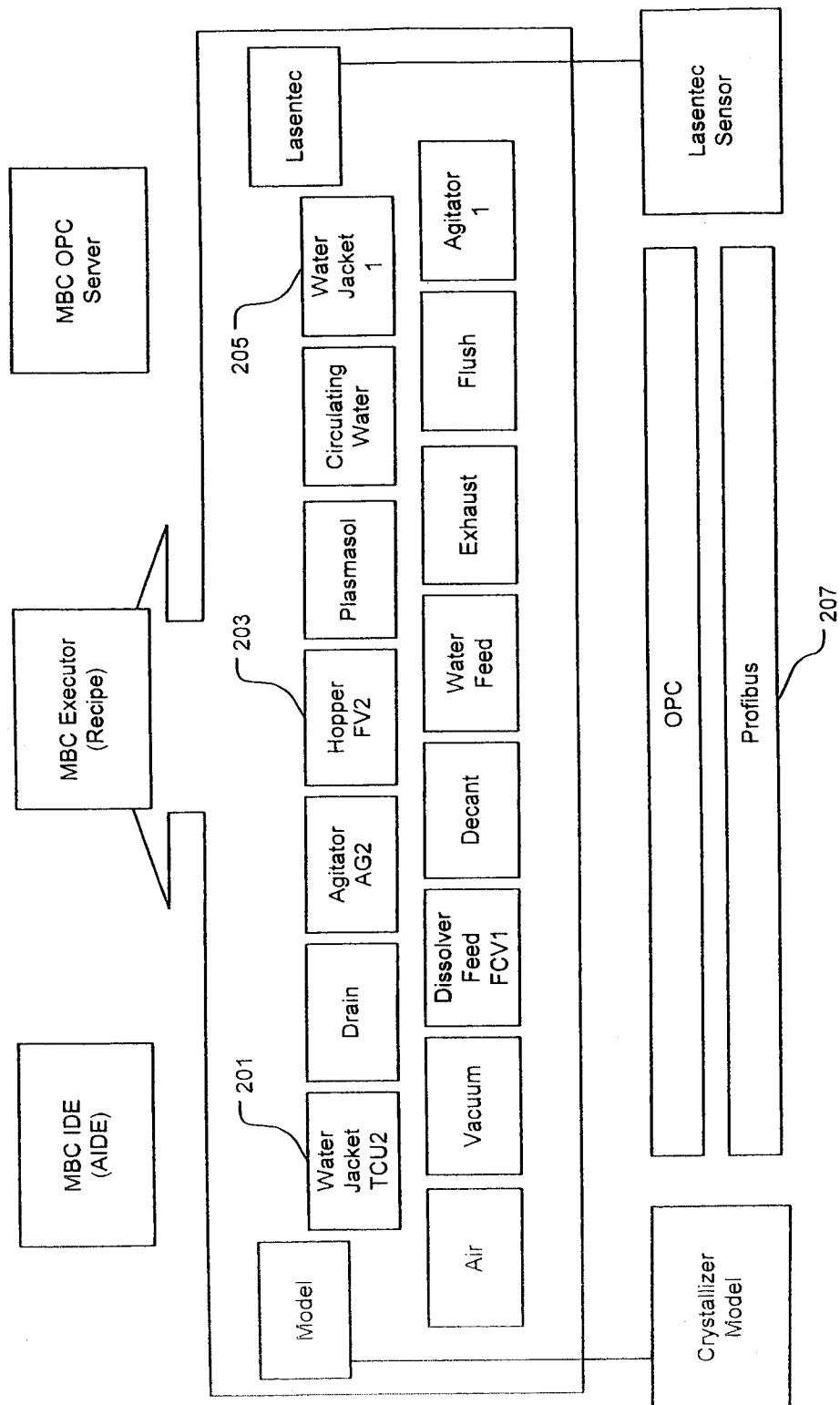


*Fig. 18*



**Fig. 19**

Fig. 20



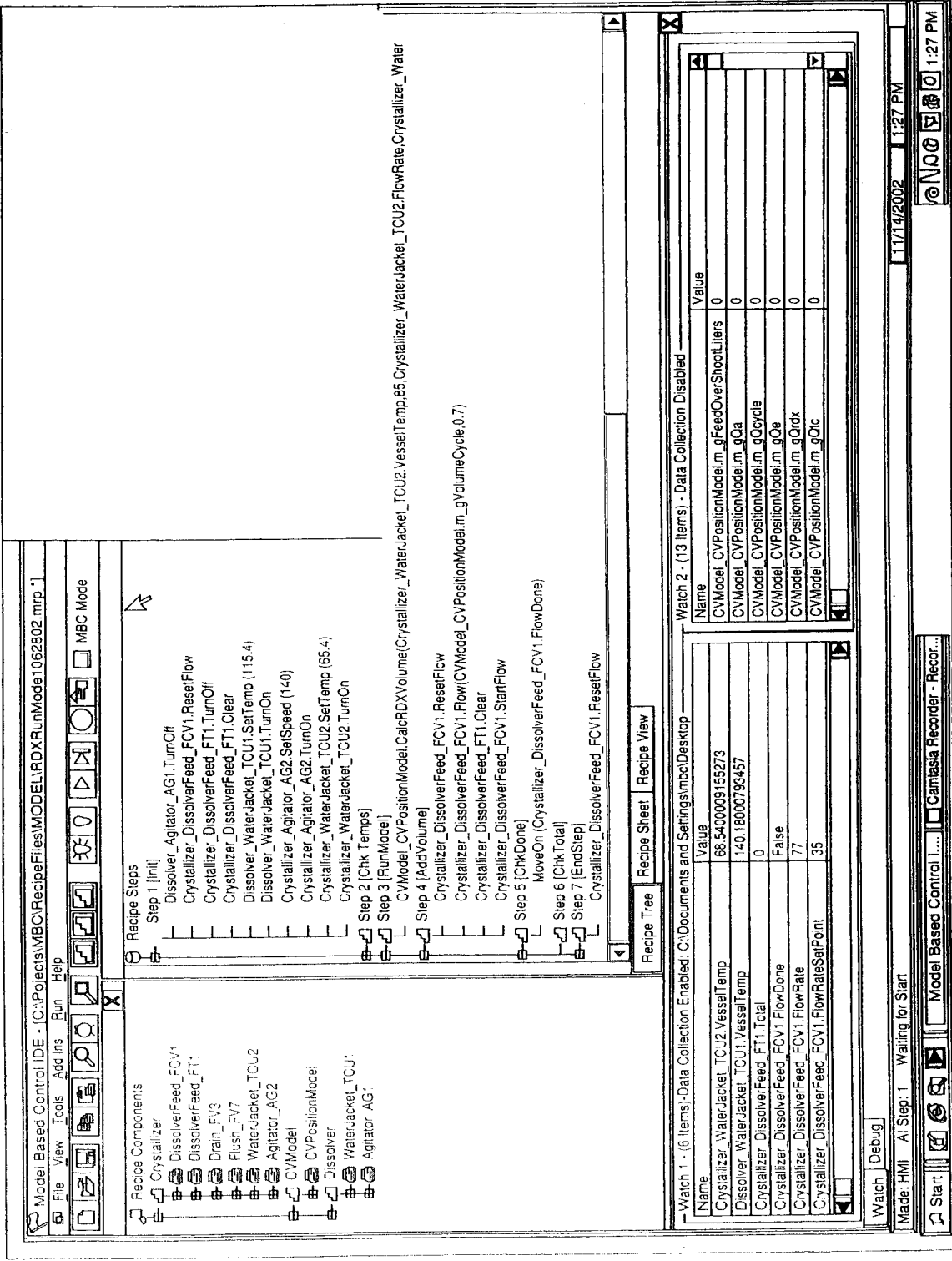


Fig. 21

Fig. 22

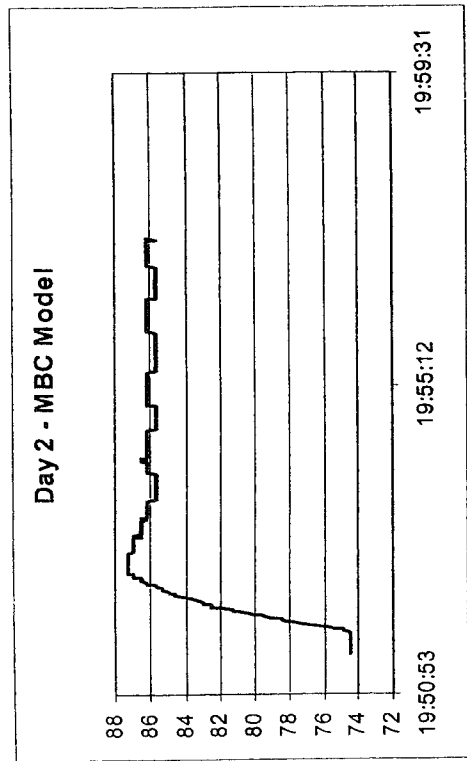
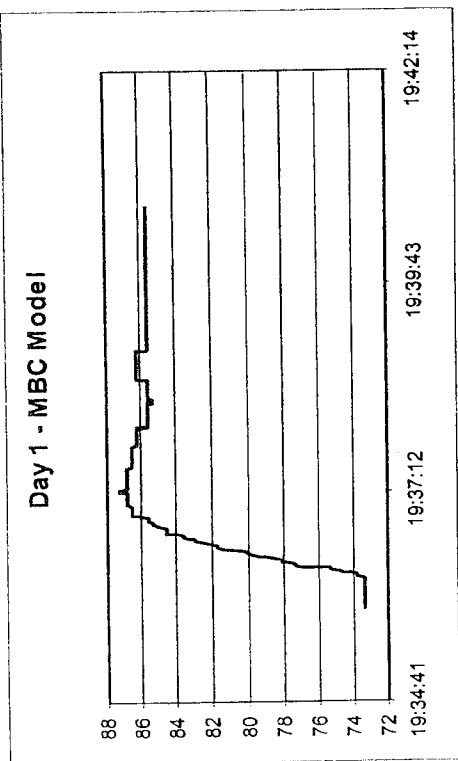
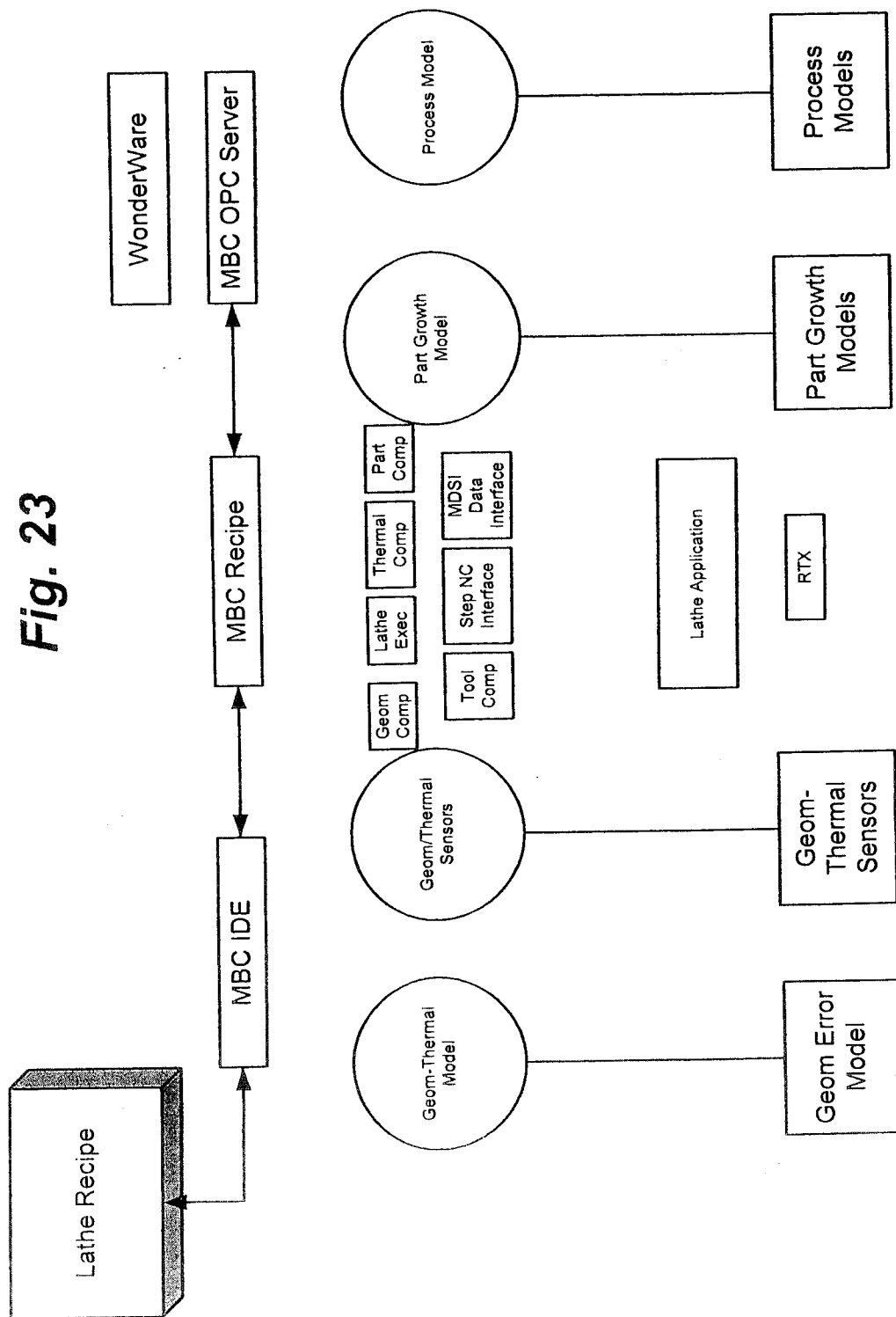


Fig. 23





**Recipe View** [X]

File Edit Recipe Window Help

Recipe Name  
C:\Projects\MBC\Data\recipe First shot - Dave.xls

Recipe State  
Waiting for Start

Date/Time  
Wednesday, October 24, 2001 - 10:13:14 A

Recipe Step  
1

Total Steps  
6

Step Time  
0

Total Time  
0

Recipe Done  
False

Keep Alive  
True

Move On Function  
MVWaterJacket1.Temp >= 58 And PVAgit

Loop  
False

Loop Time  
1000

Step Time  
60000

Recipe Step Commands

```
PVAgitator2.SetPosition ("On")
PVAgitator2.SetSpeed (80)
PVWaterJacket2.SetPosition ("On")
PVWaterJacket2.SetTemp (30.1)
PVHopper.SetPosition ("Open")
MVAgitator1.SetPosition ("On")
MVWaterJacket1.SetPosition ("On")
MVWaterJacket1.SetTemp (58.1)
```

Recipe Step Code

```
Step 1
binGoOn = False
binRunLoop = True
Do
  If binRunLoop Then
    Call PVAgitator2.SetPosition ("On")
    Call PVAgitator2.SetSpeed (80)
    Call PVWaterJacket2.SetPosition ("On")
    Call PVWaterJacket2.SetTemp (30.1)
    Call PVHopper.SetPosition ("Open")
    Call MVAgitator1.SetPosition ("On")
    Call MVWaterJacket1.SetPosition ("On")
    Call MVWaterJacket1.SetTemp (58.1)
  End If

  If MVWaterJacket1.Temp >= 58 And PVAgitator2.RPM >= 80 Then binGoOn = TRUE
  If not binGoOn Then
    Call Sleep( 1000 )
    RunTime.RecipeStepTime = RunTime.RecipeStepTime + 1000
    RunTime.RecipeTotalTime = RunTime.RecipeTotalTime + 1000
  End If
  If RunTime.RecipeStepTime >= 60000 Then binGoOn = True
  binRunLoop = False
Loop While Not binGoOn
```

Mode HMI

Run Recipe

Run Recipe Step

Stop Recipe

Continue Recipe

Cancel/Reset Recipe

Start Data Collector

251

**Fig. 24**

Item	Value
MBC.PVAgitator2.SpeedSetPoint	0
MBC.PVAgitator2.RPM	0
MBC.PVAir.OnSetPoint	0

Watch1 Watch2 Debug

**Fig. 25**

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**DataCollector**

Stats

File  Time

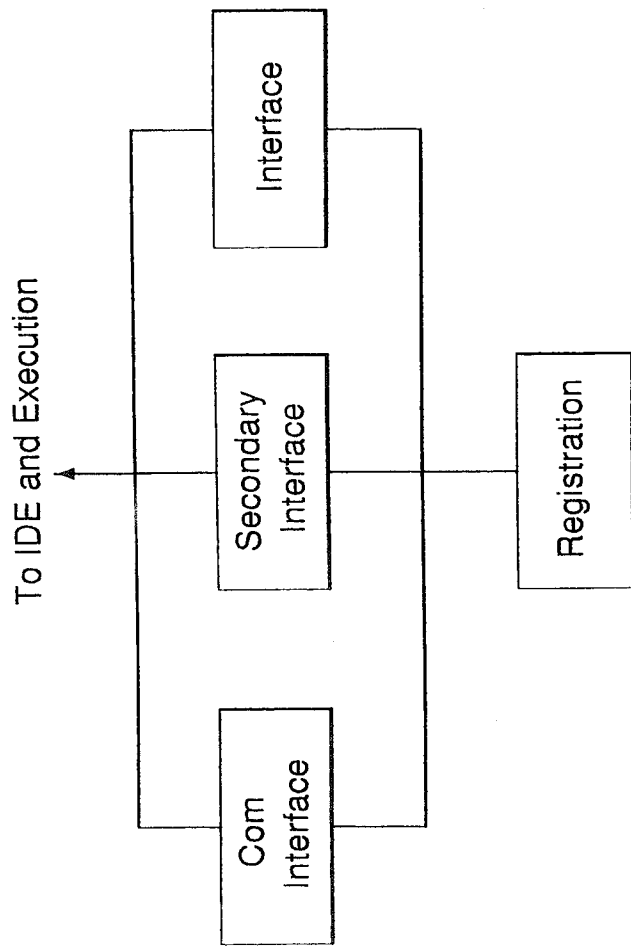
Date

ID	Name	Type	R/W	Value
1	RecipeInterface.RunTime.RecipeStepIdx	Integer	R	0
2	MBC.PVAgitator2.SpeedSetPoint	Double	R	0
3	MBC.PVAgitator2.RPM	Double	R	0.000000
4	MBC.PVWaterJacket2.TempSetPoint	Double	R	0
5	MBC.PVWaterJacket2.Temp	Double	R	0.000000
6	MBC.PVDrain2.IsOpen	Boolean	R	False
7	MBC.PVHopper.IsOpen	Boolean	R	False
8	MBC.PVDisolverFeed.FlowRatesetPoint	Double	R	0
9	MBC.PVdisolverFeed.FlowRate	Double	R	0.000000

Storage

Time (ms)  File

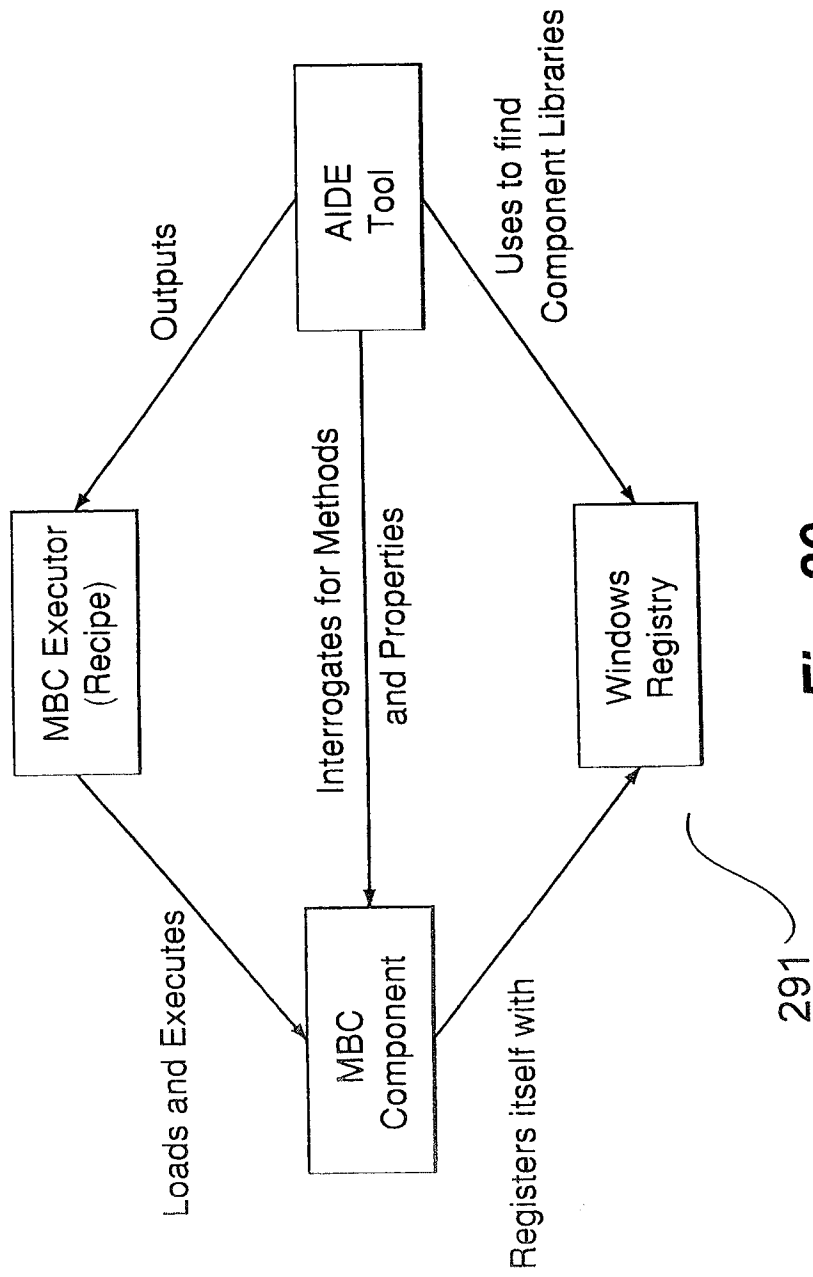
**Fig. 26**



**Fig. 27**

Library	Component
MBC	PVAgitator2
MBC	PVWaterJacket2
MBC	PVDrain2
MBC	PVWaterFeed
MBC	PVHopper
MBC	PVDecant
MBC	PVDisolverFeed
MBC	PVFlush
MBC	MVAgitator1
MBC	MVWaterJacket1
MBC	PVExhaust
MBC	PVPlasmasol
MBC	PVAir
MBC	PVVacuum
MBC	PVCirculatingWater
MBC	PVAcetoneDosing
MBC	MVAir
MBC	MVHotWater
MBC	PVLasentec
MBC	OPCModel
MBC	OPCRuntime
Recipeinterface	RunTime
Model	TBD

**Fig. 28**



**Fig. 29**

Fig. 30

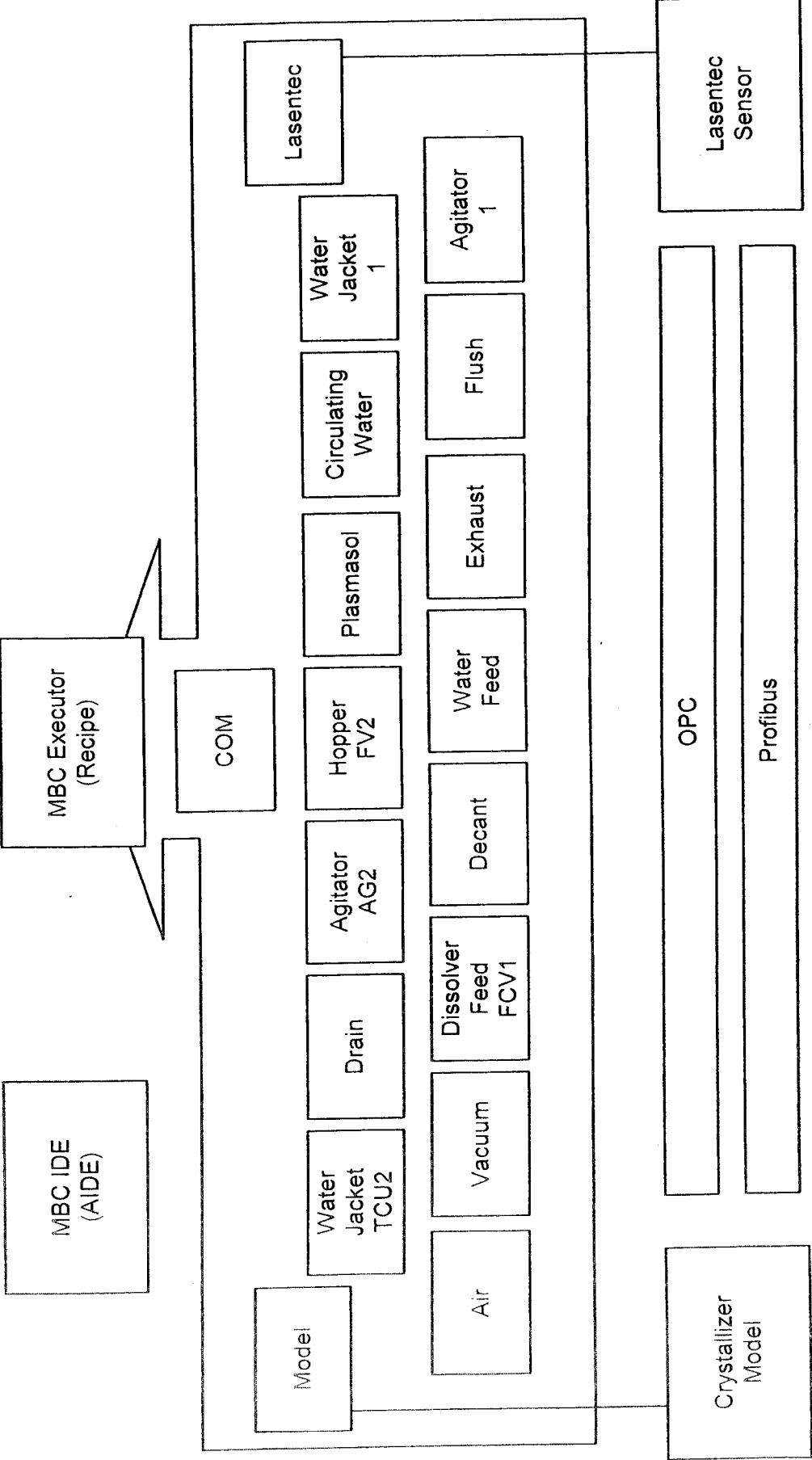


Fig. 31

311

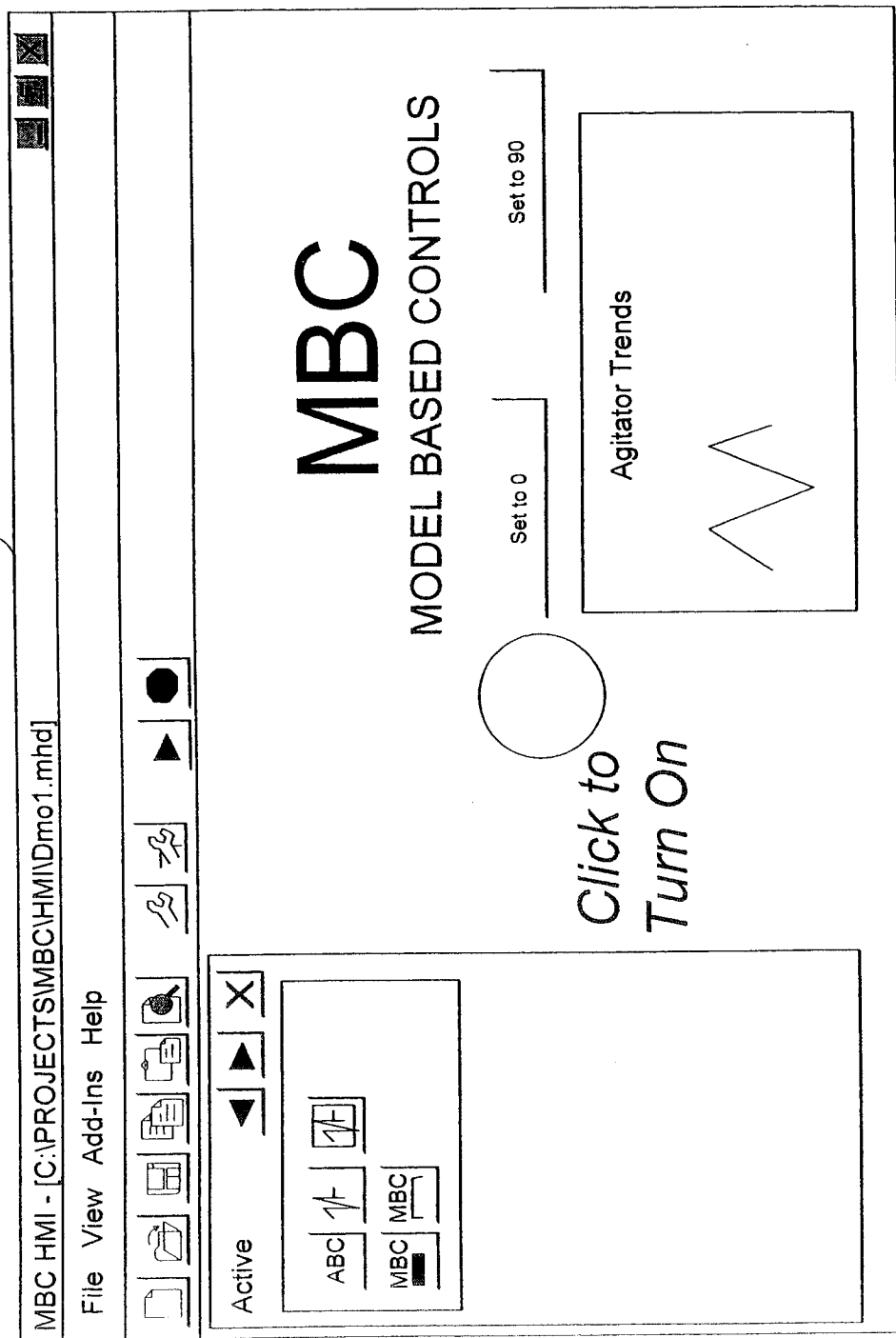
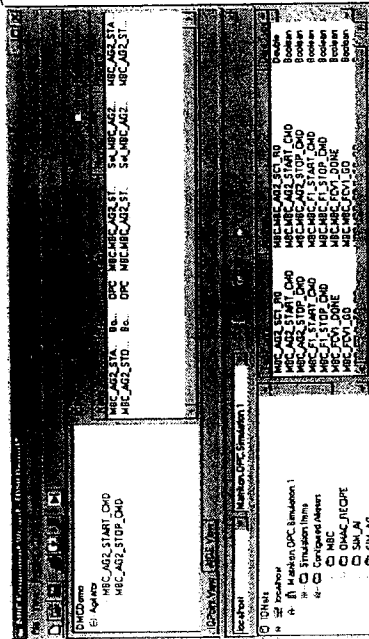
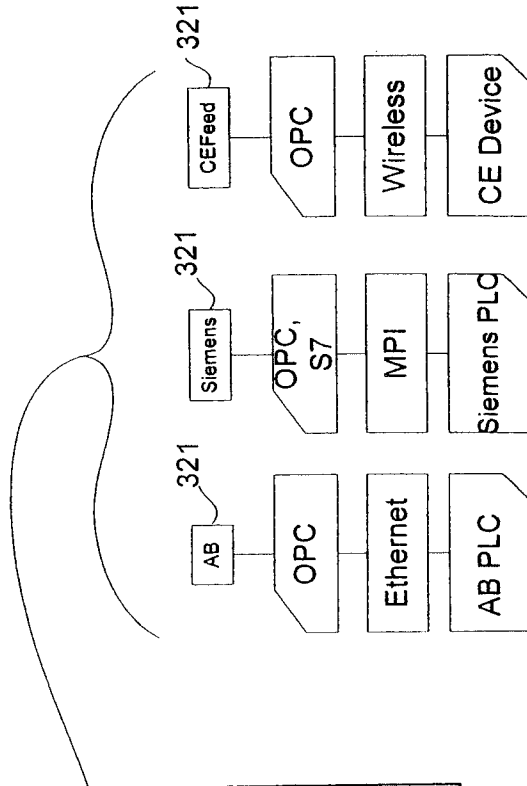
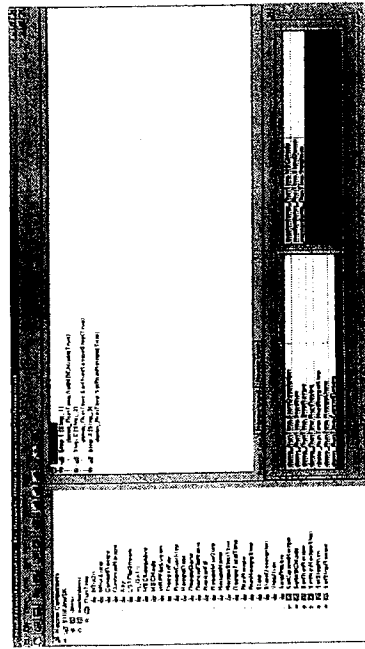
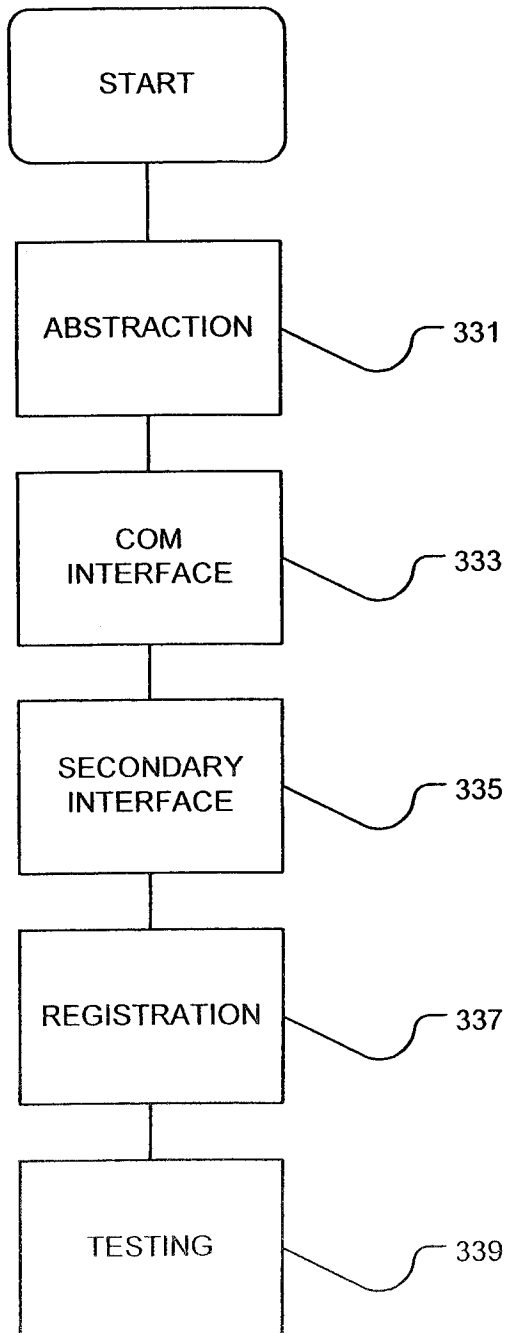


Fig. 32





**Fig. 33**



IComponent
◆ ComponentName : String
◆ IOPointList : Collection
◆ State : Integer
◆ StateName ; String
◆ SaveConfig()
◆ LoadConfig()
◆ ValidateCommand()
◆ Initialize()
◆ Reset()

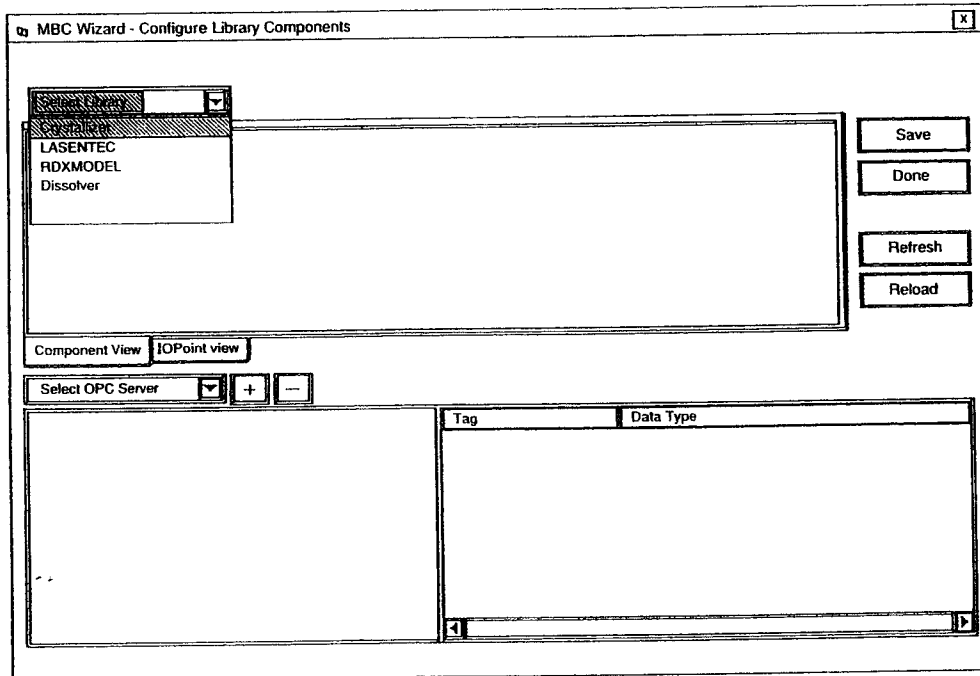
341

**Fig. 34**

clsIOPoint
<ul style="list-style-type: none"> <li>◆ Component : String</li> <li>◆ Name : String</li> <li>◆ IOType : String</li> <li>◆ Tag : String</li> <li>◆ Handle : Long</li> <li>◆ Value : Variant</li> <li>◆ Quality : Long</li> <li>◆ TimeStamp : Long</li> <li>◆ ValueRange : String</li> <li>◆ InitialValve : Variant</li> <li>◆ CanInitiate : Boolean</li> <li>◆ ScaleFactor : Double</li> <li>◆ Threshold : Long</li> </ul>
<ul style="list-style-type: none"> <li>◆ Equals() : Long</li> <li>◆ IsEqual() : Boolean</li> </ul>

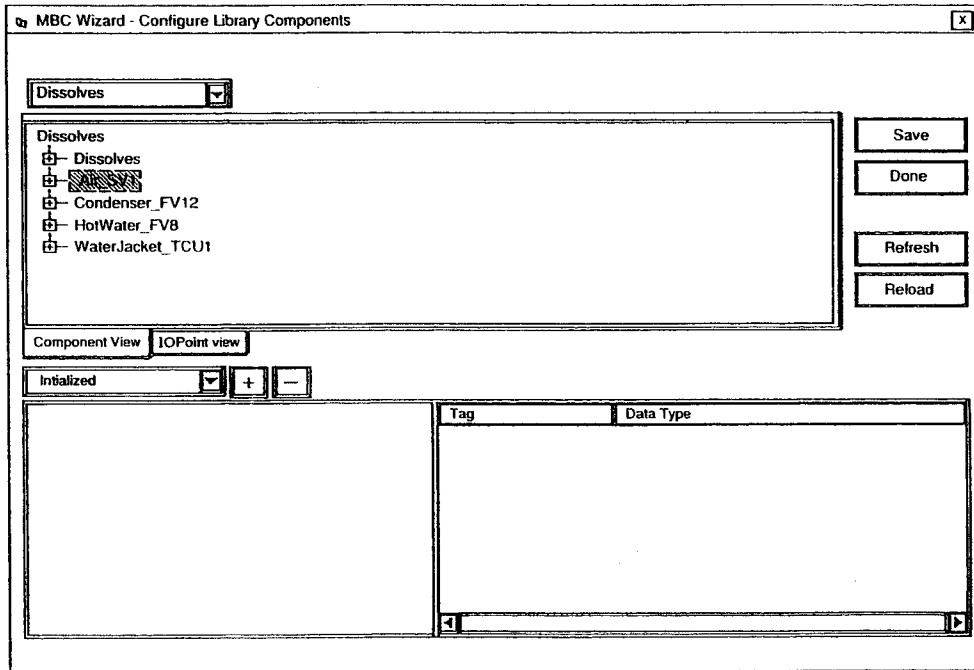
351

**Fig. 35**

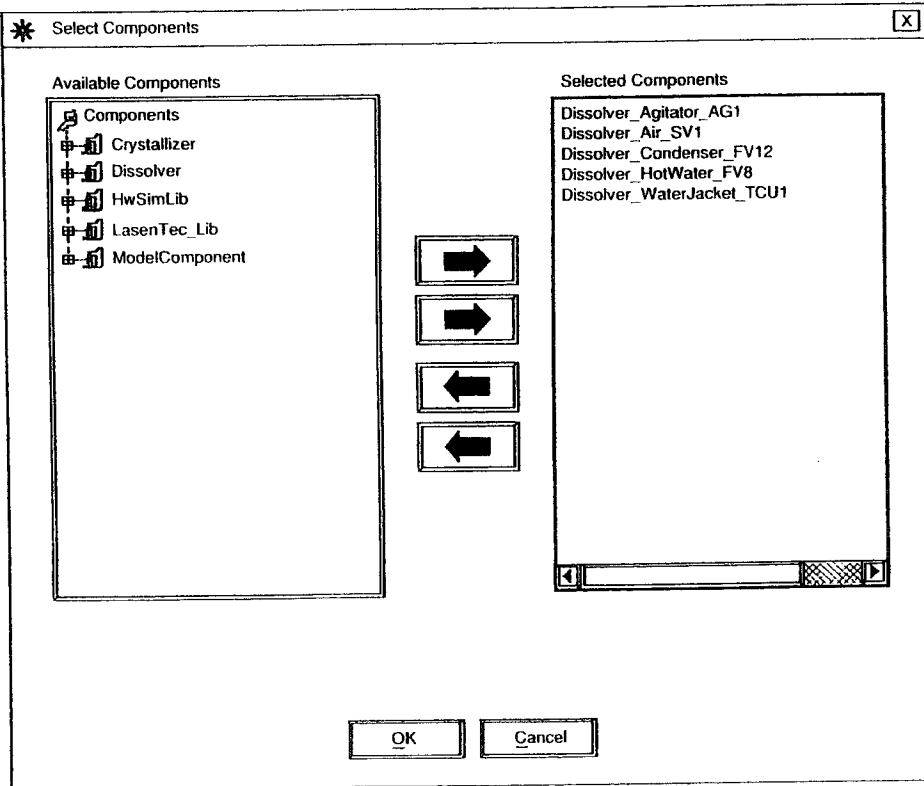


**Fig. 36**

371



**Fig. 37**



*Fig. 38*

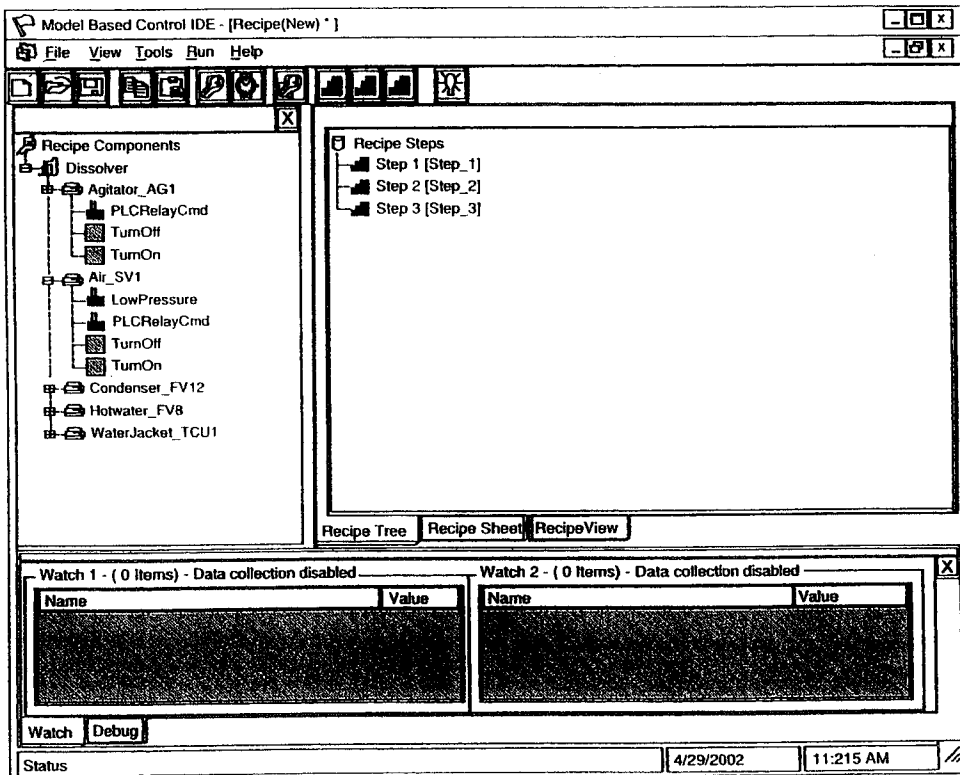
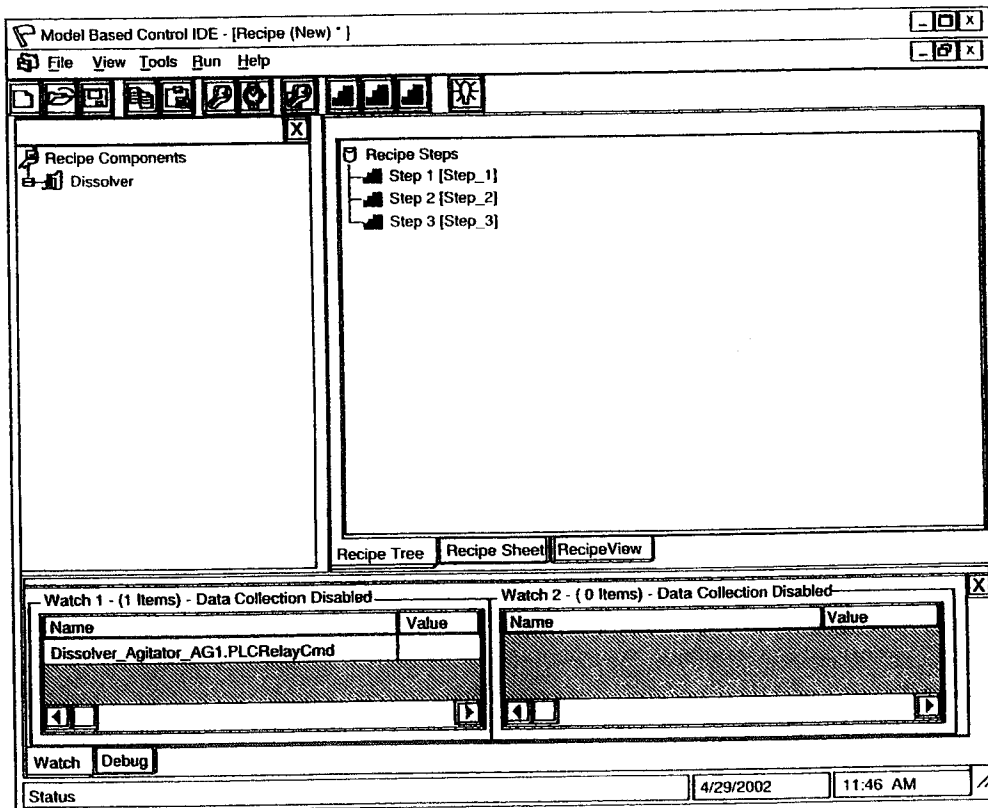


Fig. 39

*Fig. 40*



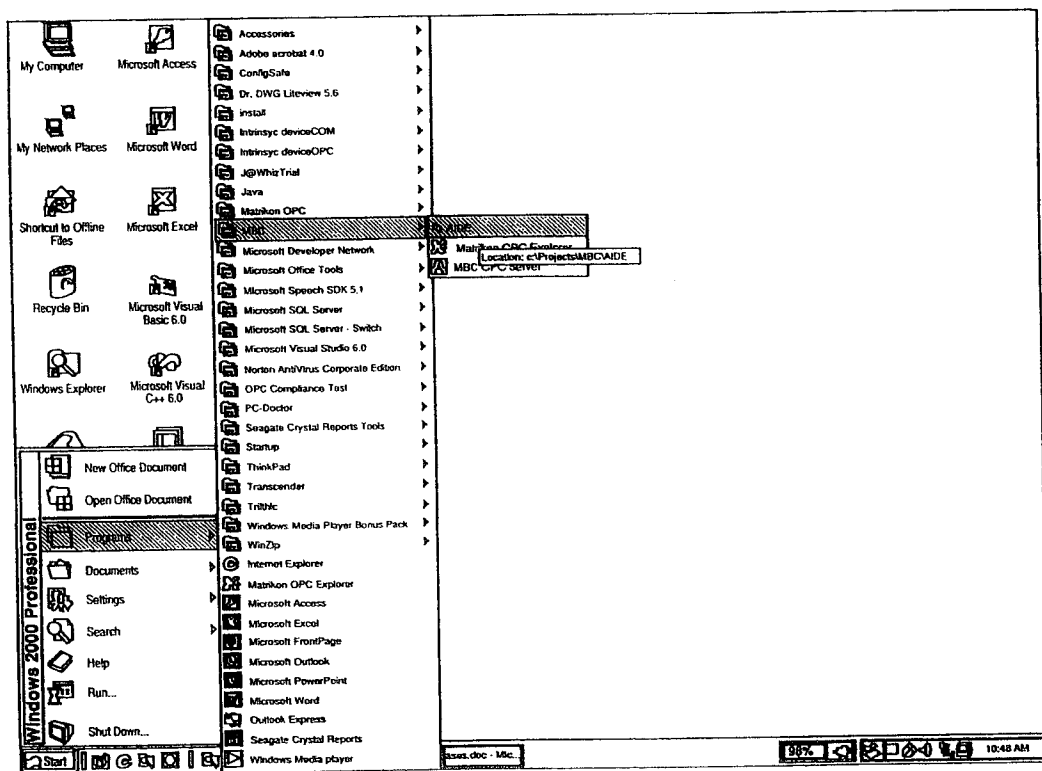


Fig. 41

Model Based Control IDE - [C:\Projects\MBCAIDEDemo.recipe.mmp]

File View Tools Run Help

Recipe Components

- Crystallizer
  - Agitator\_AG2
    - IsRunning
    - PLCRelayCmd
    - Speed
    - SpeedSetPoint
    - SetSpeed
    - TurnOff
    - TurnOn
  - Drain\_FV3
    - IsClosed
    - IsOpen
    - PLCRelayCmd
    - CloseValve
    - OpenValve
  - WaterIn\_FV11
    - IsClosed
    - IsOpen
    - PLCRelayCmd
    - CloseValve
    - OpenValve

Recipe Tree

- Step 1 [Start-Up]
  - Crystallizer\_WaterIn\_FV11.OpenValve
  - Crystallizer\_Agitator\_AG2.TurnOn
- Step 2 [Agitator\_Turn\_On]
  - Crystallizer\_Agitator\_AG2.SetSpeed(30)
  - MoveOn [Crystallizer\_Agitator\_AG2.Speed=30]
- Step 3 [Water\_Shut\_Off]
  - Crystallizer\_WaterIn\_FV11.CloseValve
- Step 4 [Agitator\_AG2.TurnOff]
  - Crystallizer\_Agitator\_AG2.TurnOff
  - MoveOn [Crystallizer\_Agitator\_AG2.Speed=0]
- Step 5 [Open\_Drain]
  - Crystallizer\_Drain\_FV3.OpenValve
- Step 6 [Close\_Drain]
  - Crystallizer\_Drain\_FV3.CloseValve

Recipe Sheet

RecipeView

Watch 1 - (4 Items) - DataCollection Disabled

Name	Value
Crystallizer_Agitator_AG2.IsRunning	
Crystallizer_Agitator_AG2.PLCRelayCmd	
Crystallizer_Agitator_AG2.Speed	
Crystallizer_Agitator_AG2.SpeedSetPoint	

Watch 2 - (4 Items) - DataCollection Disabled

Name	Value
Crystallizer_Drain_FV3.IsOpen	
Crystallizer_Drain_FV3.IsClosed	
Crystallizer_WaterIn_FV11.IsOpen	
Crystallizer_WaterIn_FV11.IsClosed	

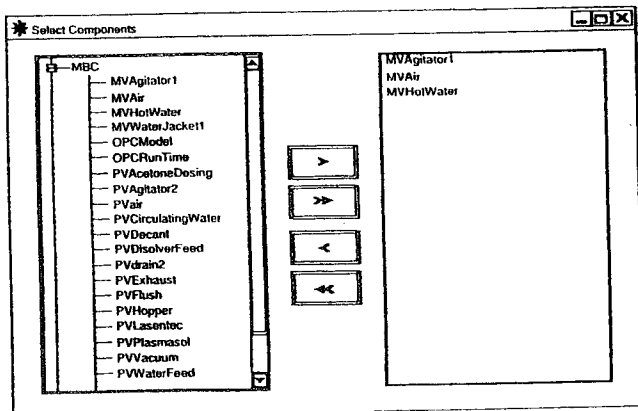
Watch Debug

Status

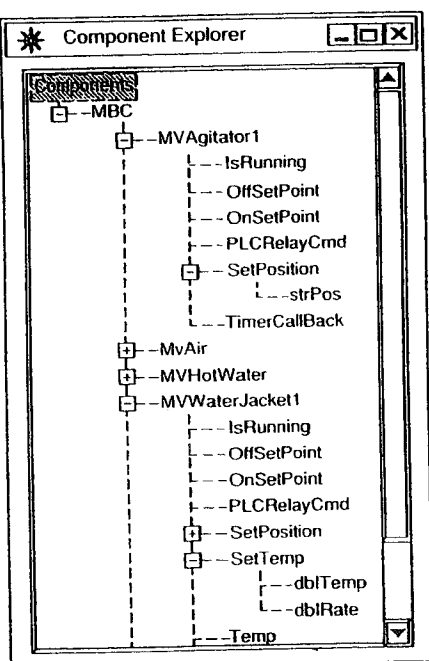
4/29/2002 9:56 AM

Fig. 42

431

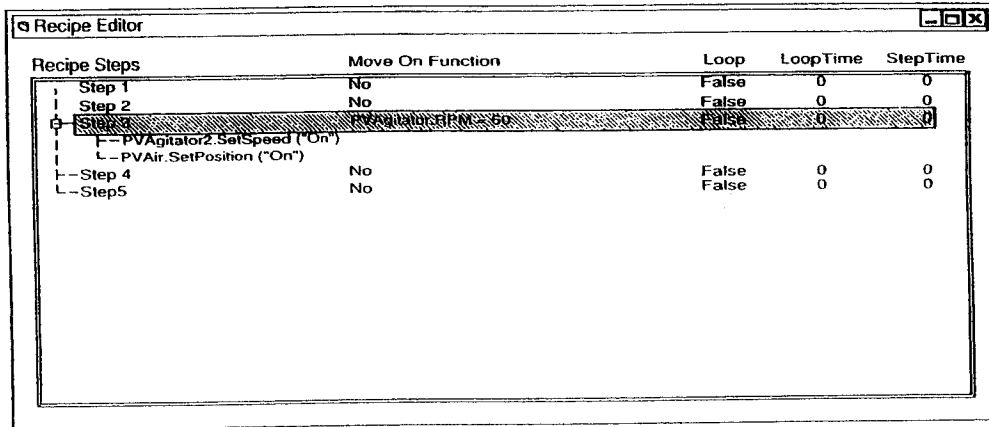


**Fig. 43**



441

**Fig. 44**



The image shows a software window titled "Recipe Editor". Inside, there is a table with five columns: "Recipe Steps", "Move On Function", "Loop", "LoopTime", and "StepTime". The table contains five rows of data. To the left of the table, there is a tree view showing a hierarchy of steps: "Step 1", "Step 2", "Step 3" (which is expanded to show "PVAgitator2.SetSpeed ('On')", "PVAir.SetPosition ('On')", "Step 4", and "Step 5"). The "Step 3" row in the table is highlighted with a hatched pattern.

Recipe Steps	Move On Function	Loop	LoopTime	StepTime
Step 1	No	False	0	0
Step 2	No	False	0	0
Step 3	PVAgitator2.SetSpeed ('On')	False	0	0
Step 4	No	False	0	0
Step 5	No	False	0	0

**Fig. 45**

**Recipe Step Detail**

Step No:  Description:

☐ Pre-Process Step

☐ Post-Process Step

**Component Commands**

MBC.PVAgitator.SetPosition("ON")

MBC.PVAgitator.SetSpeed(60)

MBC.PVAir.SetPosition("Open")

**Loop Control**

Move On:

Loop Time:

Step Time:  Units:  ☐ Loop: ☐

**Fig. 46**

Fig. 47

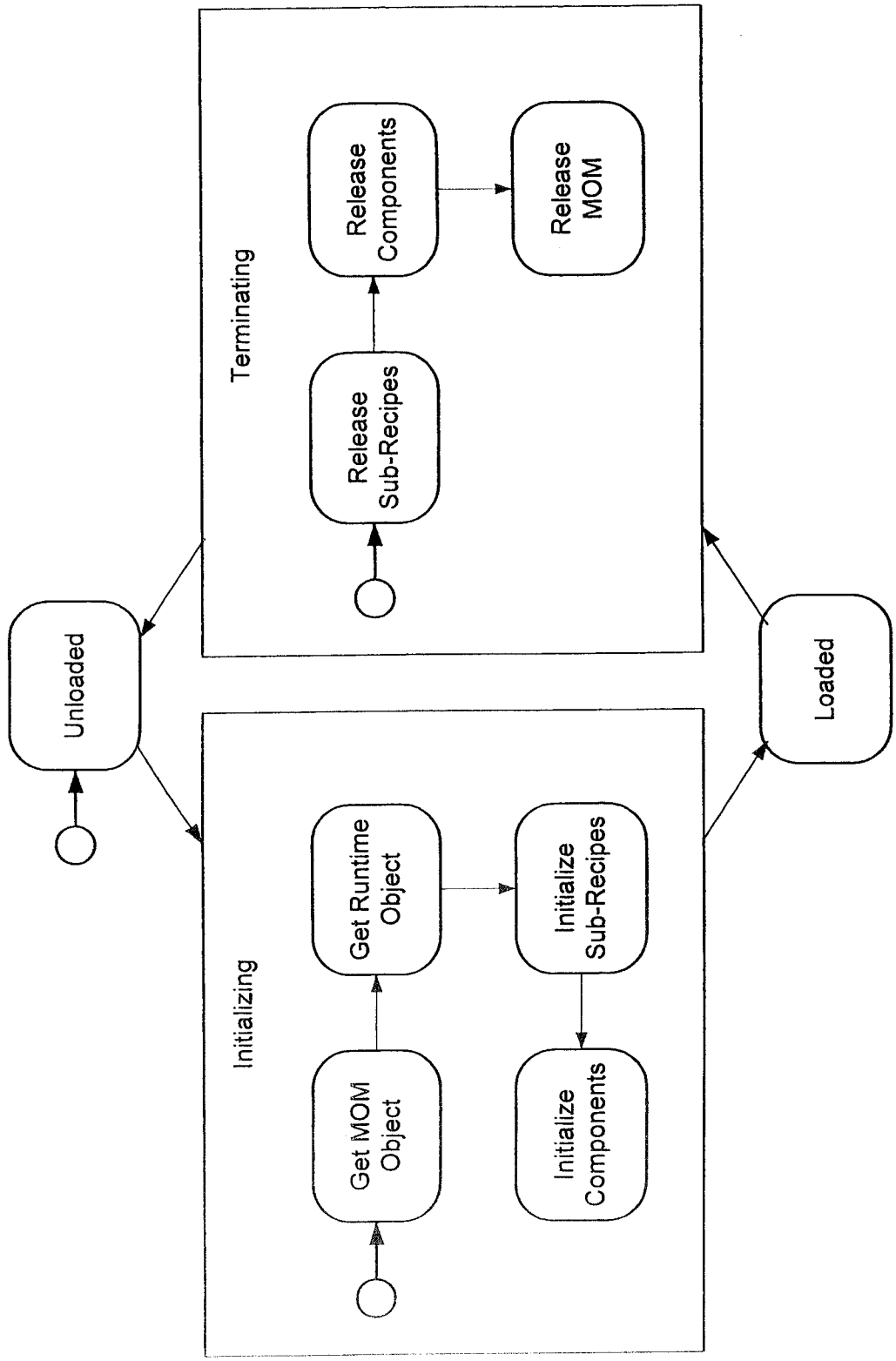


Fig. 48

Loaded

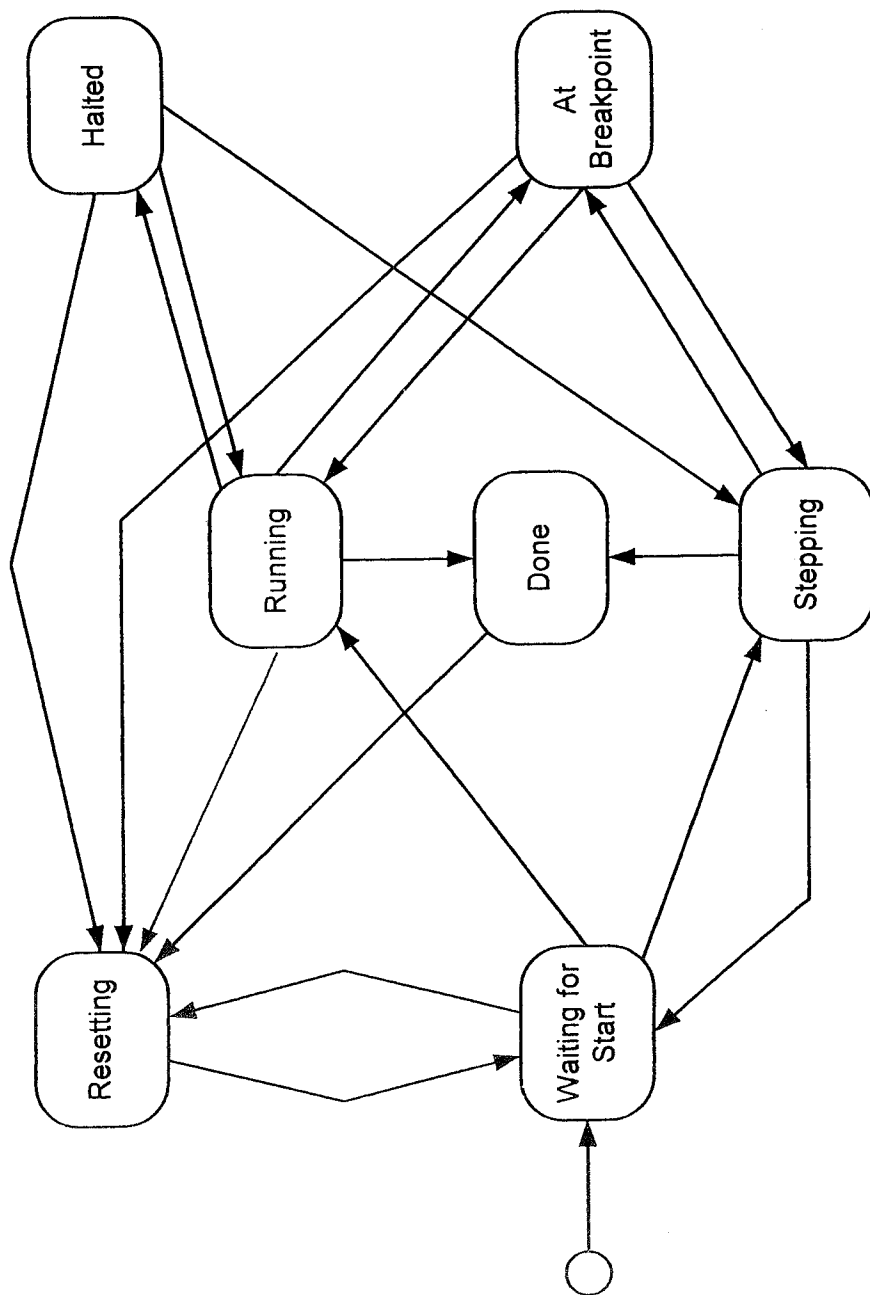
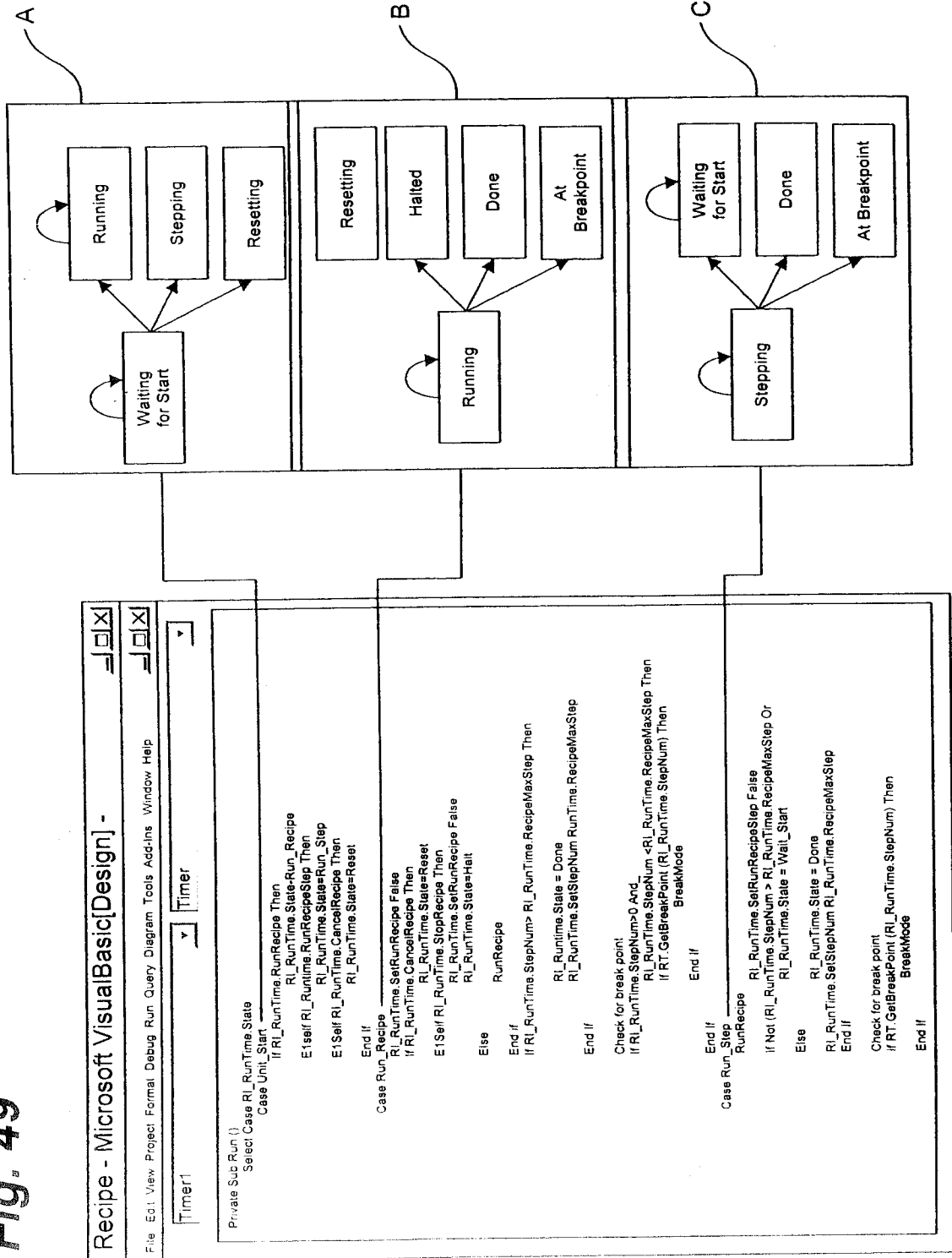
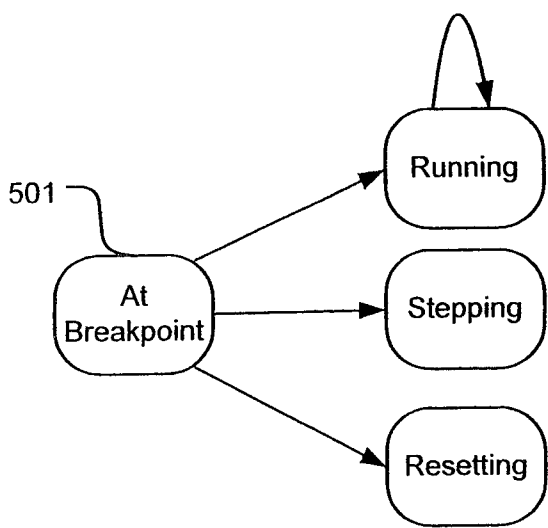




Fig. 49





**Fig. 50**

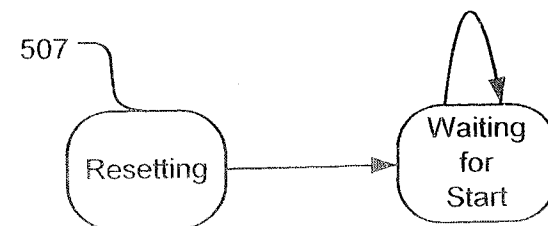
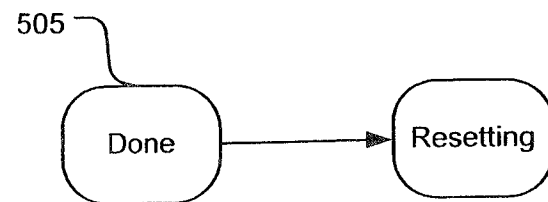
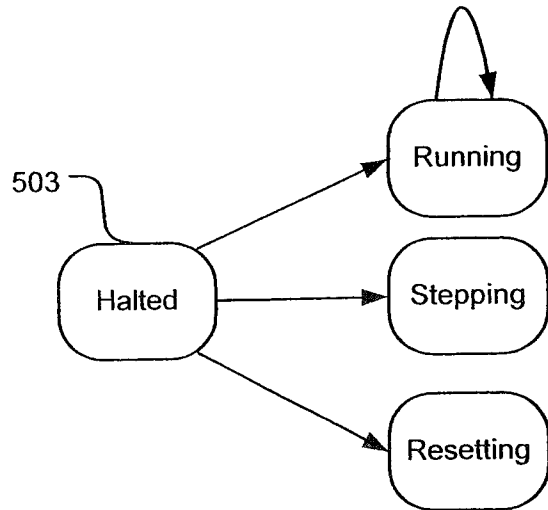
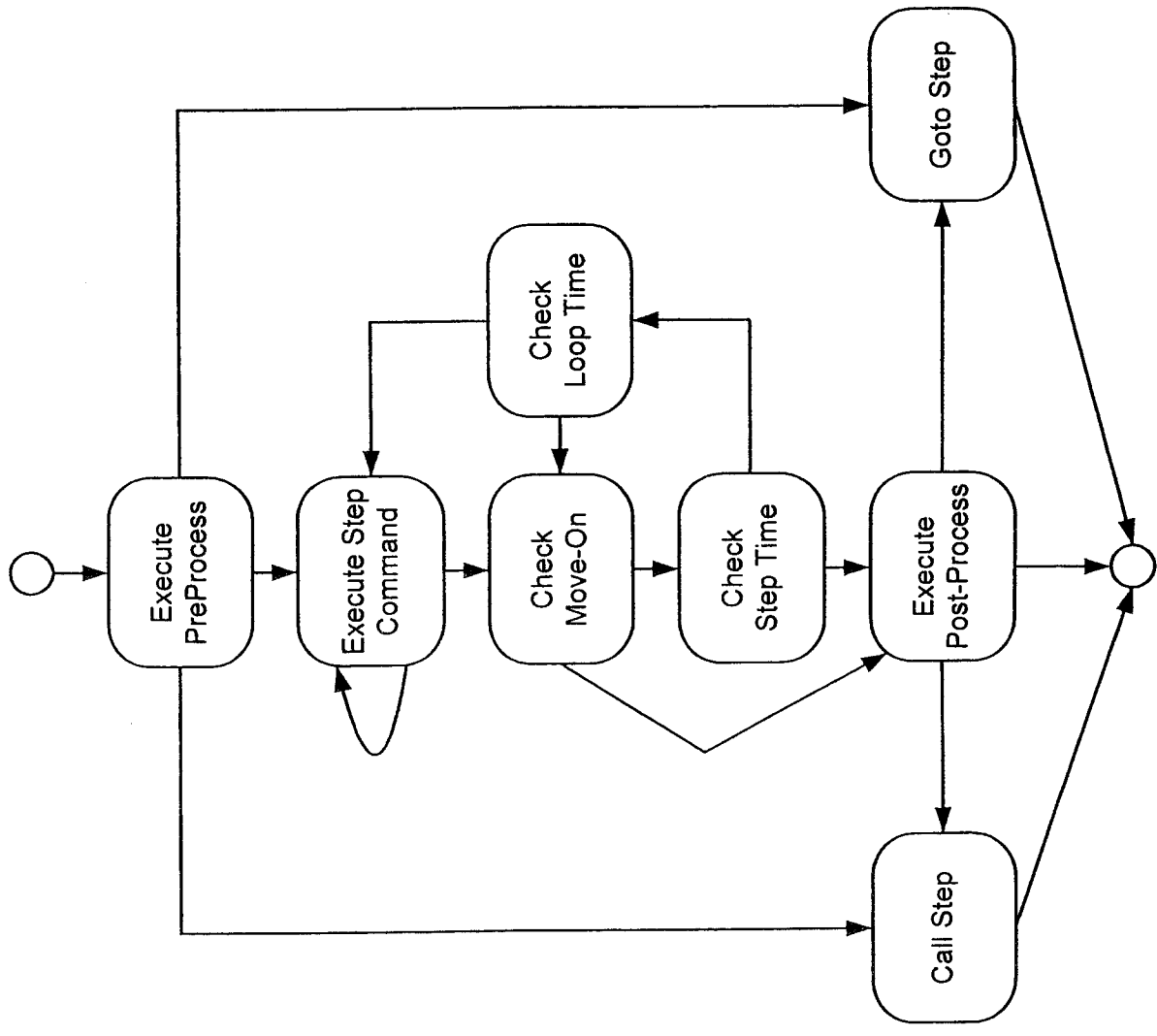
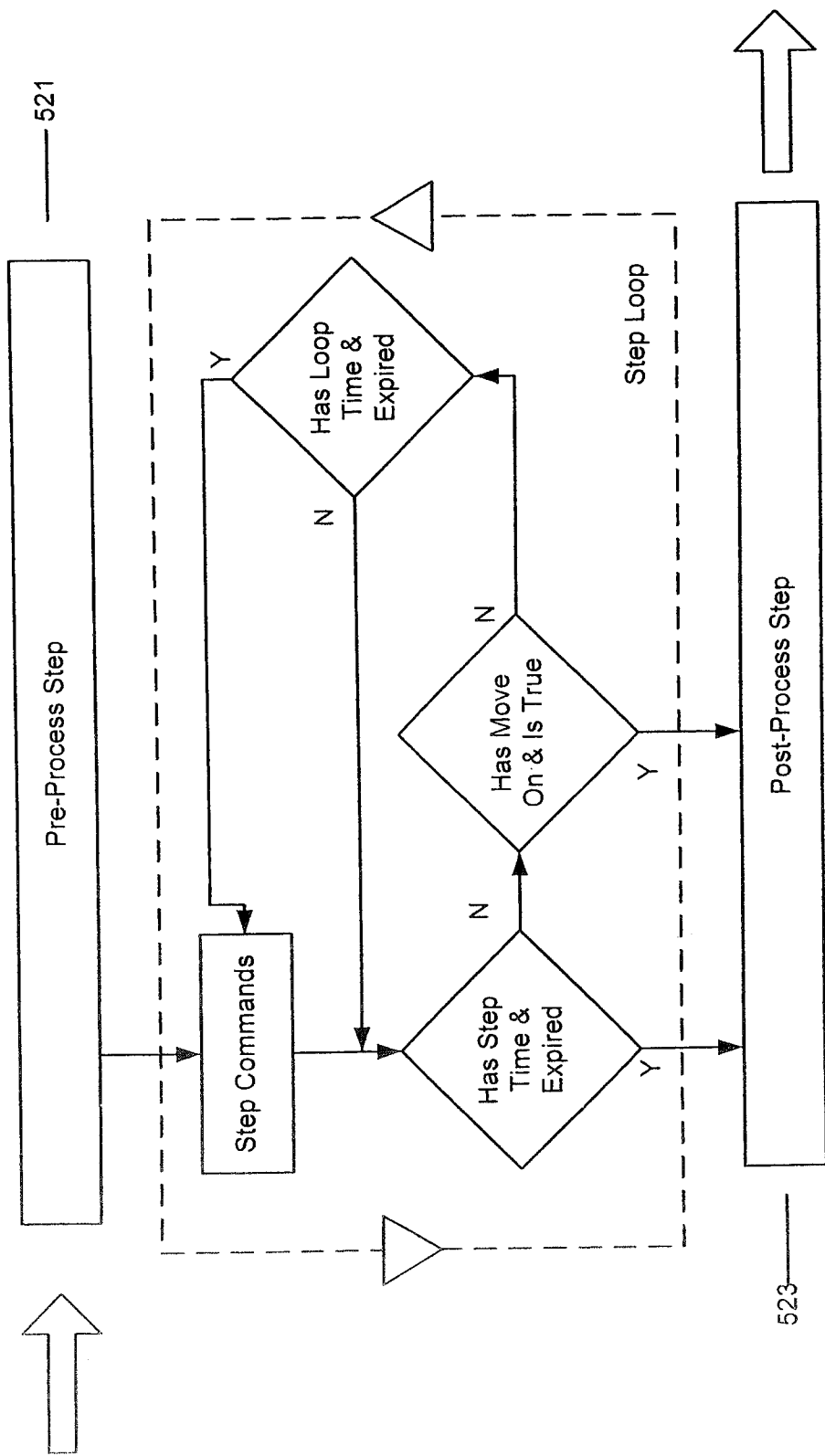


Fig. 51





**Fig. 52**

Step No. 1 Name Step\_1

Description

Pre Process

531 If M\_Mike\_LAPTOP\_Crystallizer\_Drain\_FV3.IsOpen Then  
GotoStep "Step\_2"  
EndIf

Post Process

533 If M\_Mike\_LAPTOP\_Crystallizer\_Drain\_FV3.IsClosed Then  
GotoStep "Step\_3"  
EndIf

Component Commands

M\_Mike\_LAPTOP\_Crystallizer\_dra

535

537

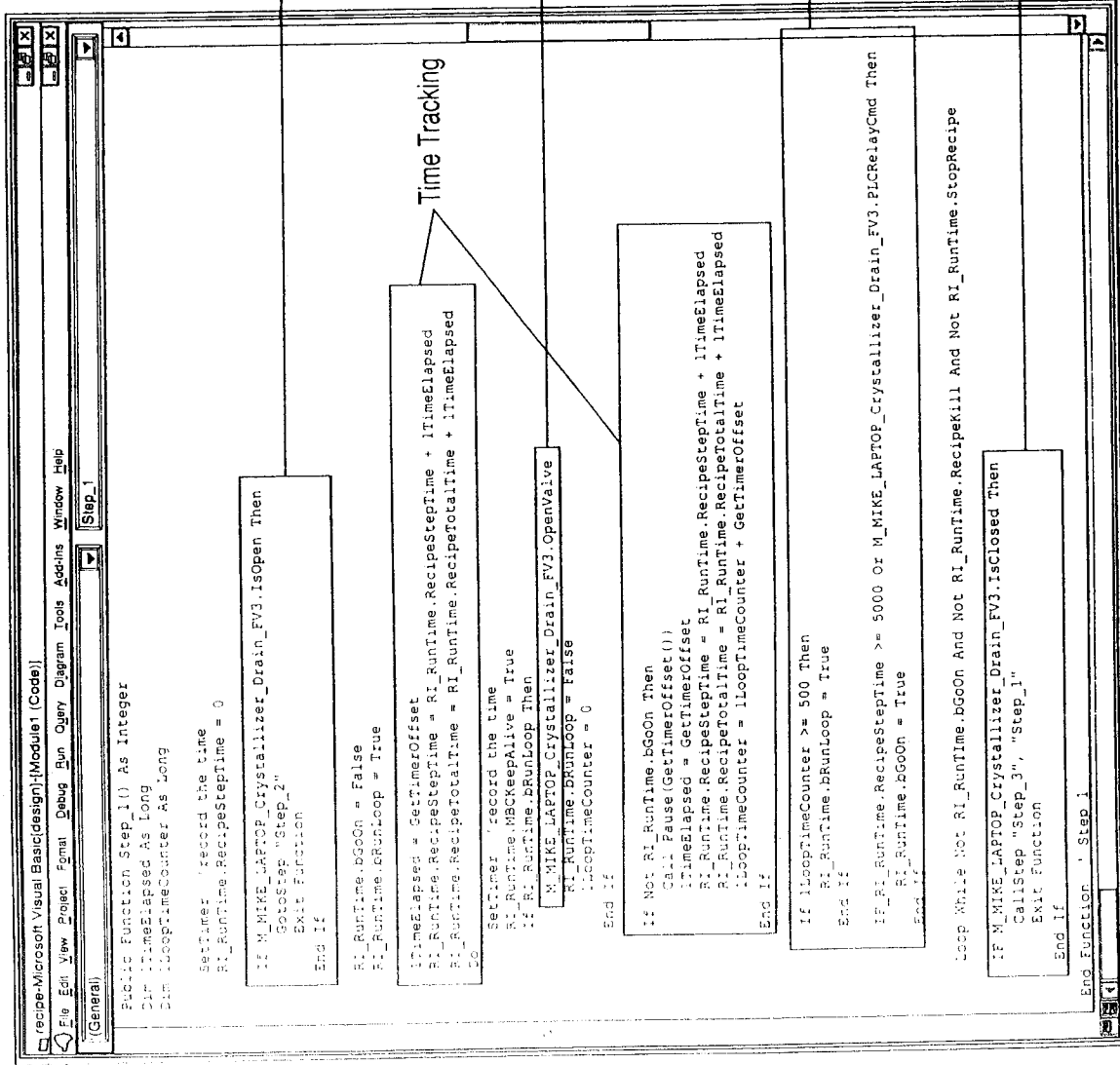
538

539

OK Apply Cancel

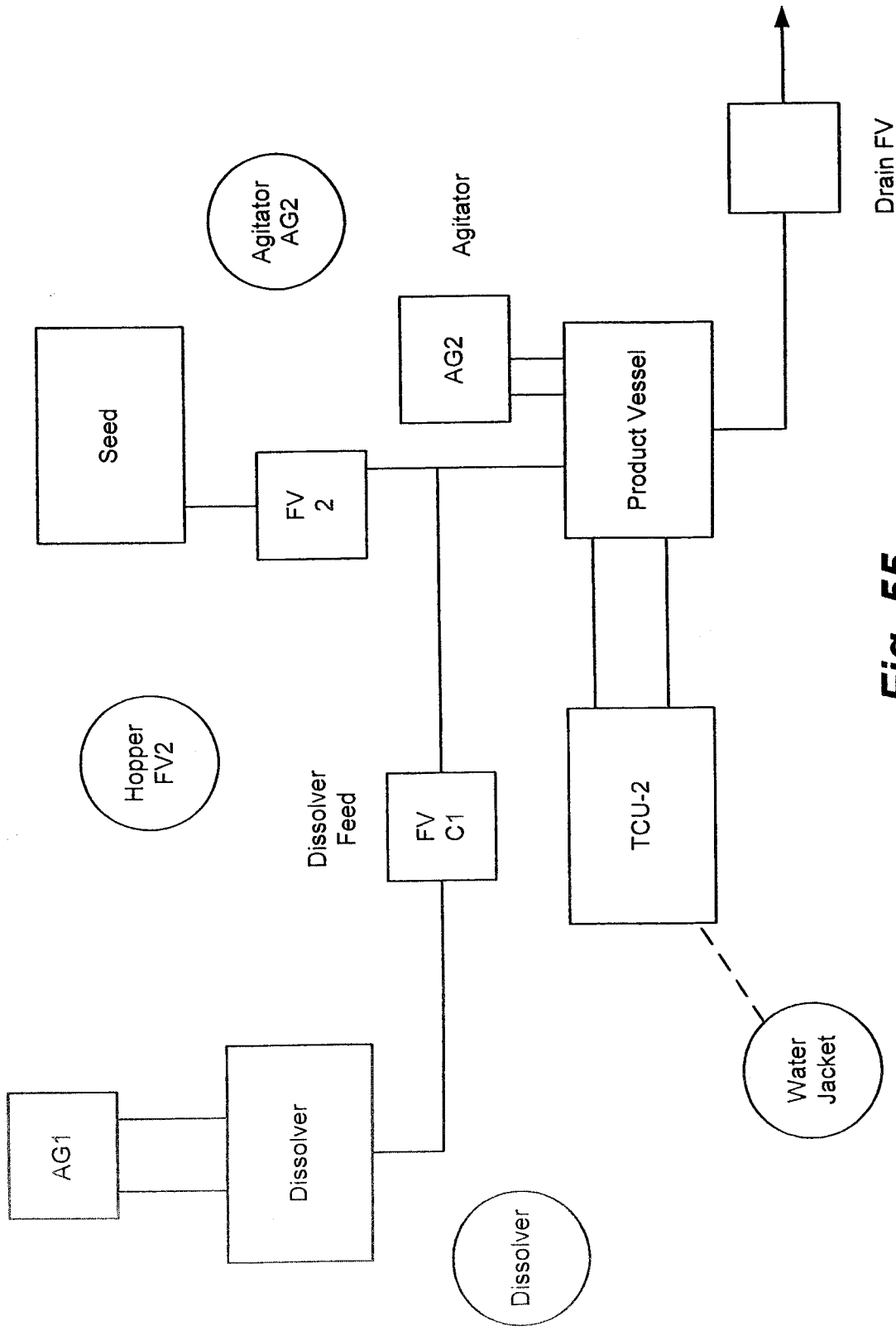
First Prev Next Last

Fig. 54



531

533



**Fig. 55**

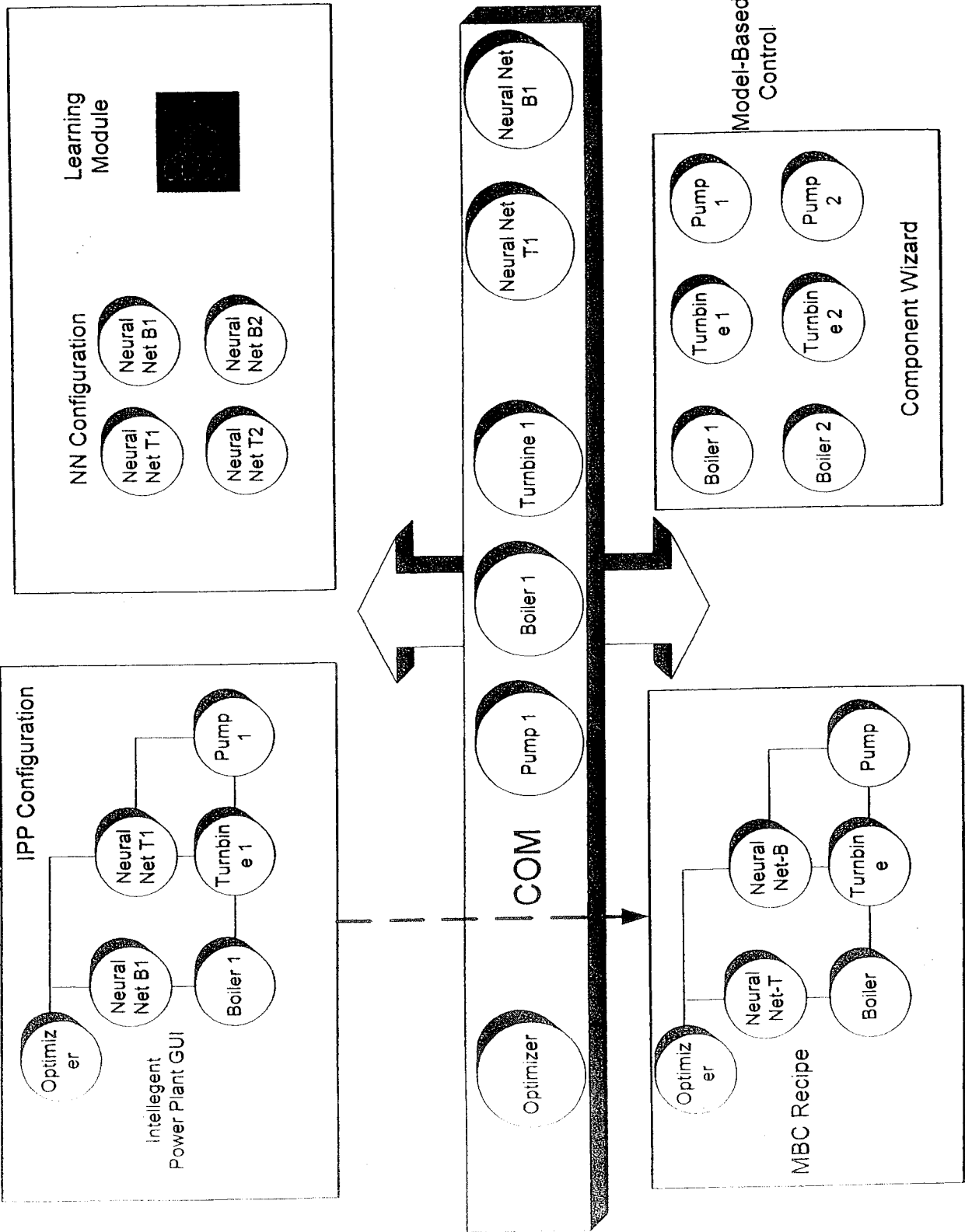


Fig. 56

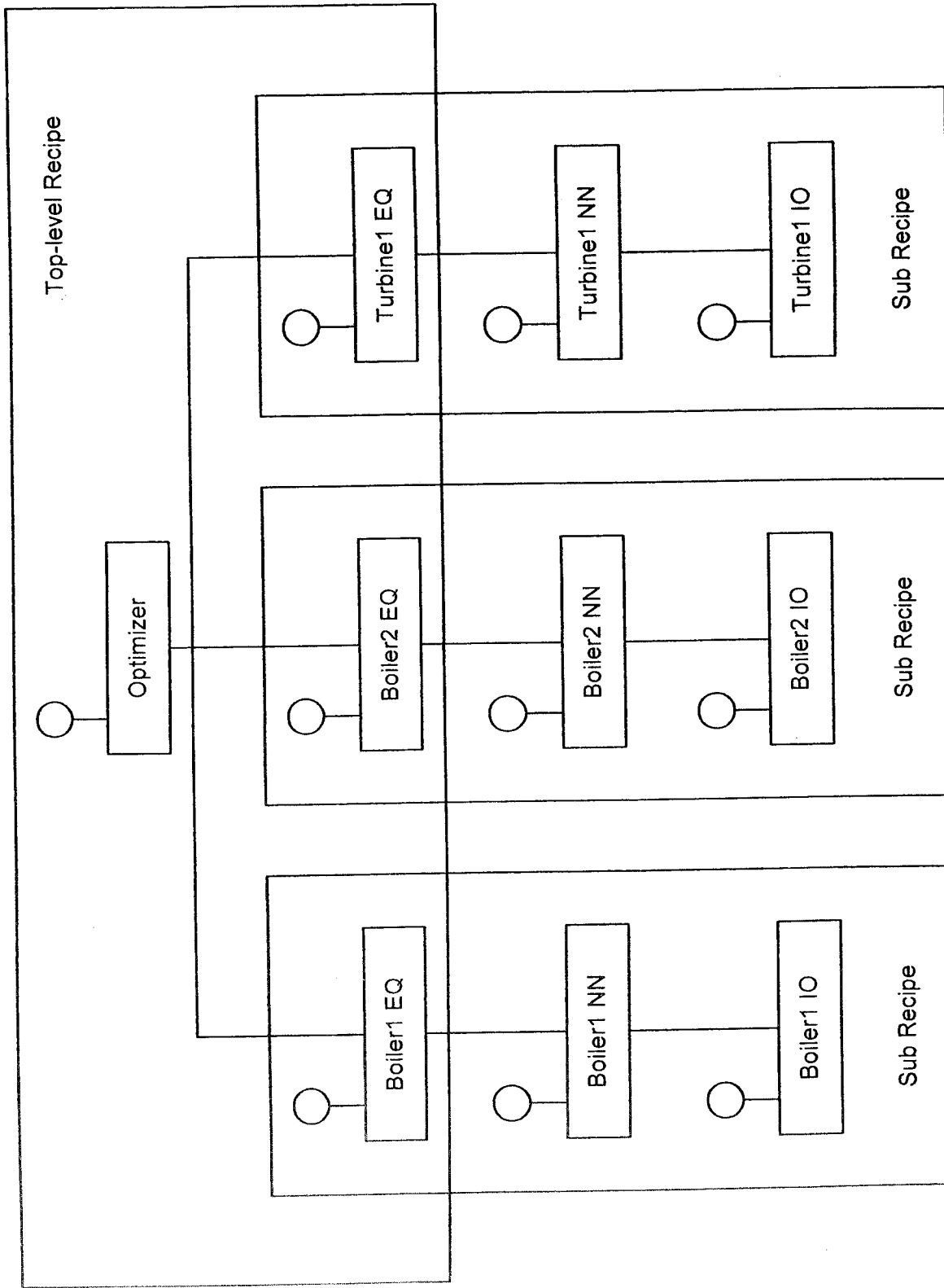
Power Plant





Mode MBC A1 Step 2 - Running

Fig. 58



MBC DC IOMServer Control Panel

DC IOMServer Configuration File

C:\Projects\Testbeds\MBCDCSim Testbed\MBCDCSim.exe.config

Open

Save

Data Collection File

C:\Projects\Testbeds\MBCDCSim Testbed\MBCDCSim\dctestfile.csv

Browse

Mode

Auto

Interval

500

State

Running

Step

9

Auto

Manual

Load

Unload

Step

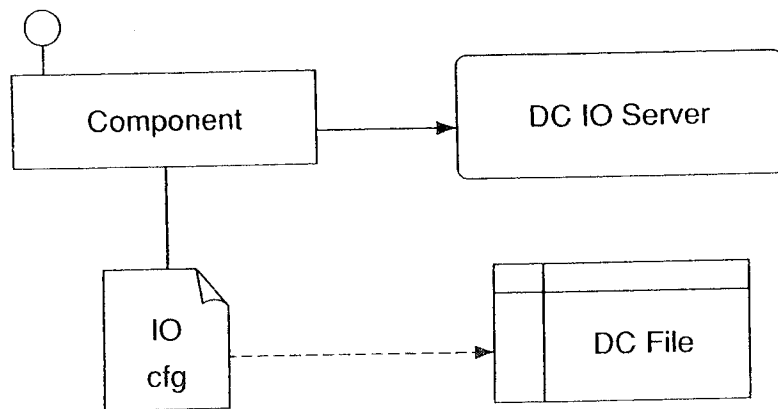
Run

Stop

Reset

Data Collection Items

RecipeInterf	RecipeInterf	RecipeInterf	RecipeInterf	AtrainData	AtrainData	AtrainData	AtrainData	AtrainData	AtrainDa
RunTime	RunTime	RunTime	RunTime	Datum	Datum	Datum	Datum	Datum	Datum
StateDescrip	RecipeTotal	Recipe Step	StepNum	HOUR	HUMID	SOLAR	TEMP	WBCW	WBE
Running	2434	2323	2	7	5.68	498.09	0	0	



**Fig. 59**

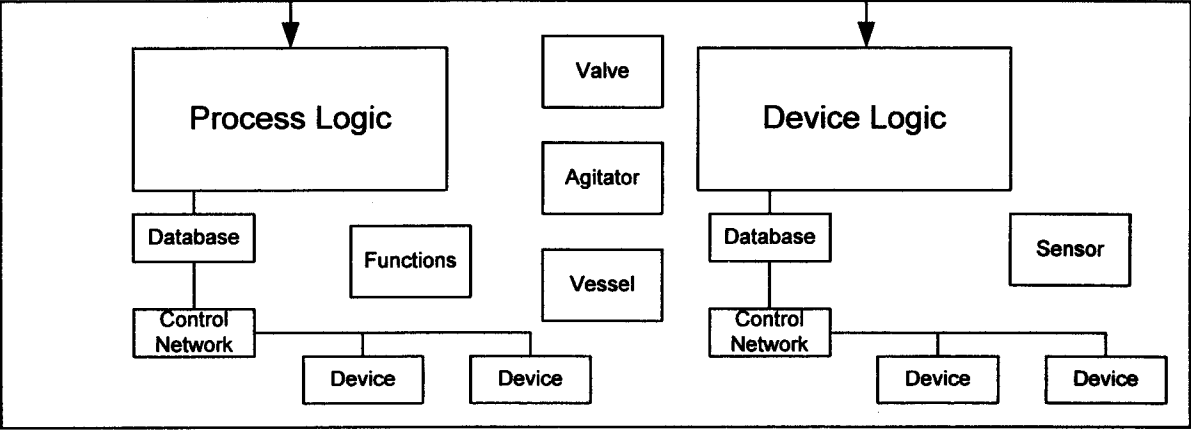
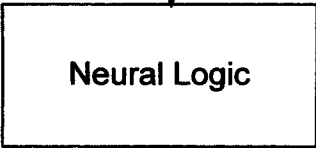
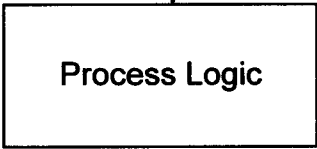
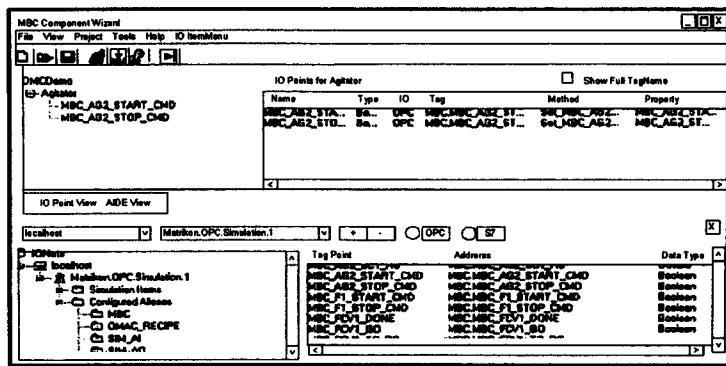


Figure 60

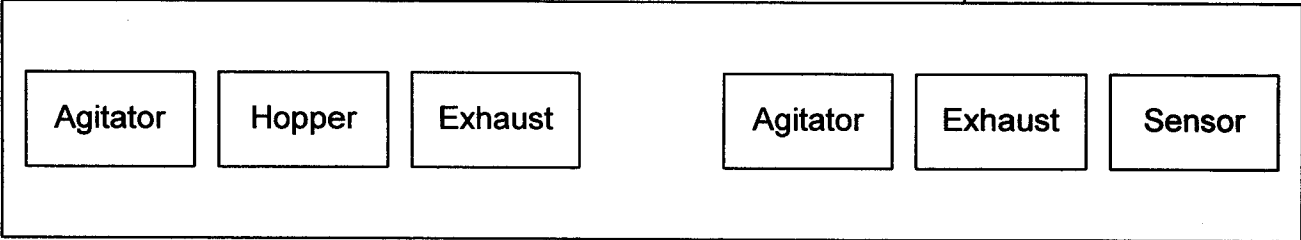
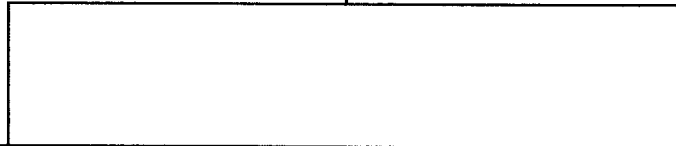
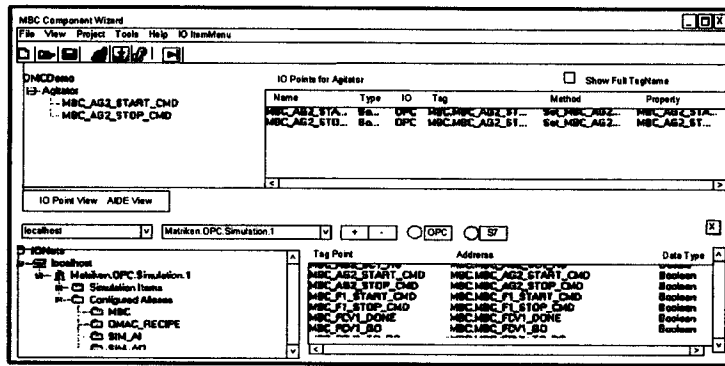


Figure 61

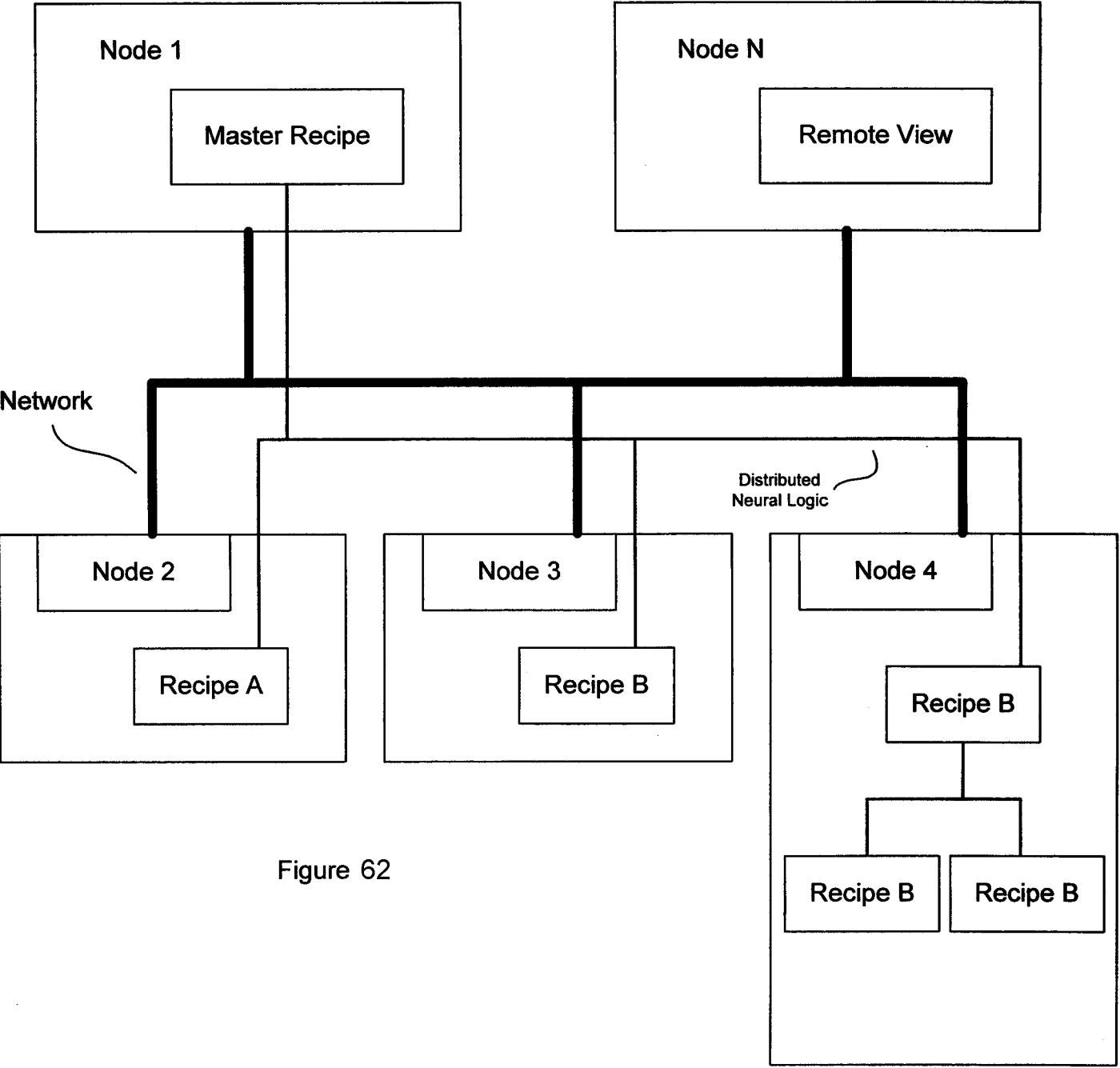


Figure 62